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COMPLETED ORIGINAL

SECOND NATIONAL ENERGY PLAN

MESSAGE

FROM

THE PRESIDENT OF THE UNITED STATES

TRANSMITTING

THE SECOND NATIONAL ENERGY PLAN, PURSUANT TO SECTION 801 OF THE DEPARTMENT OF ENERGY ORGANIZATION ACT

MAY 7, 1979.—Message and accompanying papers referred to the
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To the Congress of the United States:

I am pleased to transmit to the Congress the second National Energy Plan, as required by Section 801 of the Department of Energy Organization Act (Public Law 95-91).

The First National Energy Plan, which I sent to the Congress two years ago, was the first comprehensive effort to deal with the broad scope of the Nation's energy problems. The resulting National Energy Act, passed last autumn, acted on a number of my proposals, and will have an important and lasting role in preparing for the Nation's energy future.

But much remains to be done. And we must now deal jointly with a number of issues which have matured since April 1977.

As I said in my April 5th energy message, our Nation's energy problems are real. They are serious. And they are getting worse. Every American will have to help solve those problems. But it is up to us—the Congress and the Executive Branch—to provide the leadership.

We must now build on the foundation of the National Energy Act. In my April 5th energy address, I laid out a program for action in five areas.

First, in accordance with the Energy Policy and Conservation Act of 1975, I have announced a program to phase out controls on domestic crude oil prices by September 30, 1981. Oil should be priced at its true replacement value if we are to stop subsidizing imports, increase U.S. oil production, reduce demand, and encourage the development and use of new energy sources.

Second, the increased revenues from decontrol must not unduly or unjustly enrich oil producers at the expense of consumers. For this reason, I have proposed a tax on the windfall profits due to decontrol. Proceeds from that tax would be used to establish an Energy Security Trust Fund, which would be available, in part, to assist those low-income Americans who can least afford higher energy prices.

Third, we must provide additional emphasis on conservation and on the development of new domestic energy sources and technologies. The Energy Security Trust Fund will also provide funds for energy saving mass transit and for tax incentives and accelerated research and demonstration of new energy technologies.

Fourth, we must find ways to expeditiously develop and use our energy resources, while protecting and enhancing the quality of the environment. The length and complexity of many Federal, State, and local permitting procedures, however, has created needless complexity and increased time and cost, without improving the protection to the public or the environment. We must remove the needless red tape which is tying up many needed energy projects. I have signed an Executive Order to expedite Federal decisionmaking for certain energy projects, which are deemed to be in the national interest.

Fifth, we must provide international leadership to deal with the crisis before us today. The members of the International Energy Agency have joined in a common commitment to reduce energy consumption in response to current shortages. The United States has provided leadership in gaining this commitment. I will assure the United States does its part to meet that commitment.

The energy program I announced on April 5th puts the country in a strong position to achieve these goals. The Plan I am forwarding today shows how these programs relate to our overall energy problem, and to the other policies and programs which we must carry forward.

This National Energy Plan explicitly recognizes the uncertainties—geologic, technological, economic, political, and environmental—which confront us. It presents a strategy for dealing forthrightly with the uncertainties, with the threats and promises of our energy future.

The analysis in the Plan shows the need to move aggressively to meet the grave energy challenges to our Nation's vitality. My April 5th proposals confront those challenges squarely. Together with the National Energy Plan, we are providing a firm foundation for dealing with these challenges today and for decades to come.

Jimmy Carter

JIMMY CARTER.

THE WHITE HOUSE, *May 7, 1979.*

National Energy Plan II

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PREFACE

This is one of a series of reports on the Nation's energy policies and programs required by a variety of legislative mandates. This volume contains the Administration's second National Energy Plan, as required by section 801 of the Department of Energy Organization Act (Public Law 95-91).

A second volume, which will be published shortly, will contain an assessment of the environmental trends associated with the energy futures reported here. Detailed appendices to the Plan will be published separately.

The President has separately transmitted the Annual Report on the activities of the Department of Energy, as required by section 657 of the same Act. Several of the legislative requirements of section 657 are identical to those of section 801; accordingly, this volume is also a supplement to the Annual Report.

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OVERVIEW

The oil embargo of 1973/74 signaled a fundamental change in the ability of the industrialized nations to chart their own economic destinies and to guarantee the economic security of their citizens. Only major wars and recessions have directly affected so many people in the world's oil-consuming nations. In the U.S., the oil embargo led to nationwide shortages of petroleum, a $60 billion drop in GNP, more rapid inflation, and large balance-of-payments deficits that continue to plague the economy today.

In the winter of 1976/77, the U.S. faced another energy emergency--a natural gas shortage caused by abnormally cold weather. Factories across the country closed, leaving workers temporarily out of jobs and dramatically reducing output.

In the winter and spring of 1978, a nationwide coal strike idled thousands of workers, threatened millions of other jobs, and raised the prospect of not having enough energy to heat and light homes.

In the winter of 1978-1979, the U.S. and the world suffered yet another blow--a substantial reduction in crude oil supplies with the almost complete elimination of Iranian production. The oil consuming countries have had to borrow against current stocks, cutting into their capacity to build up supplies against next winter's cold.

In the near future, the U.S. will suffer serious shortages of unleaded gasoline unless its refineries are expanded and upgraded. Investments in new refinery capacity have been discouraged in the past by regulations that did not allow for adequate financial returns.

These past and prospective energy setbacks are only symptoms of the broader energy problem the U.S. and the world now face:

The U.S. and other major world consumers can expect more disruptions in oil supplies, at other places and at other times, as a result of events such as wars and unrest abroad, politically inspired embargoes, strikes, sabotage, and other emergencies. Over the long-term, the supply of oil will be fundamentally limited by the capacities and production decisions of those few countries in which world oil resources are concentrated. When increases in production at current prices no longer can keep pace with rising world oil demand, prices will rise sharply to bring markets into balance. As world oil supplies tighten under fundamental long-term pressures, the instability of the basic supply sources threatens even more economic and political damage to the U.S. It will make even more difficult the transition to the coming era of scarcer, more expensive energy supplies.

THE NATURE OF THE SECURITY PROBLEM

It is all too easy to be distracted by the crisis of the moment, and to overreact or to lose sight of the fundamental problems that crisis reflects. It is also easy to re-interpret long-term trends on the basis of today's headlines. Even small swings in production and consumption can create a glut or shortfall in world oil markets almost overnight. The public sense of urgency about the energy problem may change. But the dangers posed to the nation's political and economic security have now become clear and present.

These dangers have arisen from America's rapid and massive shift to consumption of foreign oil. In 1971, the U.S. imported 3.9 MMB/D, and paid only $4 billion for that oil to foreign producers. In 1979, the U.S. will likely import 8.5 to 9.0 MMB/D and, with this year's surge in prices arising from the Iranian shortages, pay an import bill of over $50 billion.

The origin of this sudden vulnerability lies in the American economy's historic dependence on a flow of cheap energy. Energy prices in the U.S. fell in real terms through most of this century. Falling energy prices encouraged greater--even profligate--use of domestic oil and gas resources. Yet the country's resources of oil and gas were finite. These powerful forces did not collide until late in the 1960s. Domestic oil production peaked in 1970 and has declined since that time. U.S. production of natural gas peaked in 1973. Yet the Nation has clung to policies and habits that try to restore the past, keep prices low and continue wasteful patterns of use. Many have been slow to recognize that the true cost of each new barrel of oil being consumed is the cost of imported oil brought in to replace domestic supply.

In the past 5 years, the price of dependence on a few oil producer countries has been a series of unpleasant economic shocks. The first OPEC price increase of 1973/74 quadrupled the cost of oil, helped push the U.S. into a recession, and required painful adjustments from which it has only lately recovered. Oil imports have directly raised the cost of everything in the U.S. that uses oil or oil substitutes, and thus have been a direct and indirect source of U.S. inflation. They also have contributed to the large U.S. trade deficits in 1977 and 1978 which led to the recent depreciation of the dollar.

Finally, the rise in world oil prices has affected every American's standard of living. The U.S. economy has had to give up more and more goods and services to pay for the same amount of foreign oil. Americans are simply not as well off when the terms on which they buy a vital commodity such as oil change so adversely.

This dependence on foreign oil has also ushered in a new era of political instabilities. In today's world--with little warning--a revolution, war, or political embargo in the Middle East can quickly and severely disrupt American economic activity. The political and military security of a few producing countries around the world has become of major significance for all oil-consuming countries. As the events in Iran have demonstrated, internal unrest in any major OPEC producer country can cause sudden problems in world oil markets. Closure of the Persian Gulf could plummet the U.S. and the other industrialized nations into a world-wide depression.

Over the next decade, the energy security problems facing the U.S. could worsen. The underlying supply and demand pressures for major world oil price increases in the 1980s are great. Any surplus production capacity that individual OPEC countries may have developed in recent years will almost certainly vanish by the mid-1980s, perhaps sooner. Producer governments with limited ability to absorb huge revenues have strong incentives to reduce output below maximum technical limits and keep world oil markets tight.

Unless there are major changes in forecasted energy production and consumption trends or efforts by governments, world oil prices by 1990 could reach $30 per barrel. Adjusted for inflation, this is up to $55 per barrel in 1990 prices. These increases are almost certain not to occur in any smooth or predictable way. Recent experience suggests that prices will rise in spurts as markets adjust, belatedly or prematurely, deliberately or inadvertently, to new realities. This erratic behavior is likely to aggravate the recessionary shocks and painful adjustments to higher prices.

The greater the long-term rise in world oil prices, the more they will slow world economic growth, dampen new investment, reduce employment and worsen inflation. Developing countries would suffer even greater direct harm than advanced industrialized nations; with the growing interdependence of the world economy, however, vulnerability to energy problems is a collective danger.

The U.S., and the governments of the other consumer nations which are already linked in the International Energy Agency, are not powerless to influence the world energy situation, however. For their own security, they have no choice but to do so. They can limit the economic damage from higher world oil prices, and limit world oil price increases. Through policies that encourage conservation and use of alternative fuels, consuming nations can reduce the demand pressures that would lead to high world oil prices. They also can stimulate development of new, higher-cost energy technologies and resources, which can be introduced at the proper times to help limit further price increases. It will be essential, as world oil prices rise, to ensure that such higher-cost substitutes for oil are available quickly and in the quantities needed.

PLANNING FOR UNCERTAINTY

The U.S. cannot develop a satisfactory energy policy until it recognizes the need to plan for a wide range of uncertainties. Despite a flood of energy forecasts and prognoses in recent years, no one can predict with certainty the Nation's energy future. But it is possible to understand better the forces that will shape that future.

The first set of uncertainties concern supply. The world has vast oil and gas resources. The basic doubt is whether enough new oil sources can be discovered and produced at current prices to meet even a low growth in world oil demand. More and more of the world's oil has come recently from high-cost, hostile environments. Many geologists believe that most of the world's largest fields have already been discovered, and that future discoveries may be smaller in size than in the past. As production from existing fields declines, successful discoveries would have to occur at a rate never before experienced to prevent large jumps in world oil prices.

Meanwhile, some of the countries in which world oil resources are concentrated are unlikely to produce at their maximum technical limit. They will seek to stretch out their oil supplies, and to seek the level of revenues that best meets their own needs for internal political and economic development. These supply factors could change, however. Stepped-up exploration outside OPEC could lead to unexpectedly large discoveries of new oil sources. Changing revenue needs of OPEC governments could lead to higher or lower output.

The second set of uncertainties concerns world energy demand. The world's appetite for oil in the next two decades will depend on economic growth, which is very difficult to predict. Conservation can hold down energy demand growth, but government policies, consumer behavior and the energy-efficiency of new capital goods and buildings are notoriously hard to predict, and their effects are hard to estimate. These factors will determine whether and how fast world oil demand reaches the limits of OPEC and non-OPEC production capacity.

Many other uncertainties also will affect future world oil price behavior. These include technological change, the policies of consumer-nation governments in developing substitutes for oil, and the role that communist governments will play in world oil markets as exporters, importers or both.

In short, the timing and size of price increases are clouded with uncertainty. However, under a broad variety of assumptions that span the range of responsible opinion, it is almost inevitable that demand at current prices will exceed supplies at those prices at some time during the 1980s. It would be rash to ignore these uncertainties, take comfort from the existence of optimistic forecasts, or use them to justify inaction. The U.S. must plan for pessimistic and optimistic futures, and anticipate the problems and benefits that can emerge in all such futures.

Price is not the only measure of a "good" or "bad" energy future. Low oil prices bring short-run economic benefits, but lead to higher import levels and greater long-run political insecurities and economic vulnerability to import disruptions.

High oil prices may lead to reduced import levels, although non-market constraints on increased domestic supplies could emerge that would keep imports high. The U.S. must develop policies that balance and protect against the risks of higher prices, higher imports, or both.

TOWARD A U.S. ENERGY STRATEGY

Since the first OPEC price increase of 1973/74, the U.S. energy situation has continued to deteriorate. While there has been increased emphasis on conservation and demand growth has slowed, domestic production of energy has remained stationary for almost a decade.

The Nation stands at the threshold of a major transition in its sources of energy supply. Over the next two decades, the U.S. will meet its future demand growth not only with oil and gas, but increasingly with coal, nuclear power, renewables, and high-cost unconventional sources. No longer can it easily turn to imported oil to fill the supply gap, as it has in the past. Foreign oil will no longer be cheap and readily available. Moreover, the political costs of dependence will have become even more apparent and unacceptable.

The challenges of the transition period are inherently formidable. Development of new transitional supplies and the development of new markets for those supplies will take many years and require enormous investments over a long period of time. Yet the effort is critical and, apart from political security benefits, the potential cost savings would be enormous. Actions too long delayed could have disastrous consequences.

To date, interminable conflict over the future of energy policy has been one of the most paralyzing uncertainties in the country's energy future. Only with the President's energy message of April 5 is the Nation finally moving towards an oil pricing policy that ends the subsidy for foreign oil. Institutional barriers have blocked increased energy production and new energy projects. Frequently, businesses have hesitated to undertake new projects or raise their production because of delays and uncertainties about government policies.

The energy policy debate has been one of the most divisive in recent years. Energy policy touches every economic interest, every group in American society. It leads into a complex tangle of sometimes competing national goals--market efficiency and greater production, equity among income classes and regions, environmental protection, national security, economic growth, and inflationary restraint. It will be difficult, and sometimes impossible, to reconcile all these goals.

An energy strategy must build on the National Energy Act of 1978. It must develop a consensus on issues that were not treated in the NEA, and on new issues that have arisen since. It must define a more active role for regional, State and local governments in addressing the vast array of energy problems that cannot be solved at the national level. It must demonstrate a new creativity in reducing the welfare and equity impacts of higher energy prices. It must determine how to balance the costs of short-run inflation with the benefits of long-run inflationary restraint. There is no alternative but to confront the difficult choices that lie ahead.

THE NATIONAL ENERGY STRATEGY

An energy strategy must balance those measures that improve the Nation's long-run security and those that better prepare it to deal with sudden crises. It must recognize the different problems that can emerge in three time-frames: the near term (from now to 1985), the mid term (from 1985 to 2000) and the long-term (2000 and beyond).

The Nation cannot resolve all the energy issues facing it now or at any one time. Every decision must be made carefully with recognition that more knowledge will permit wiser choices later. The main objectives of the strategy, nevertheless, must be to offer constant policy guidance for an uncertain future.

The Near Term (1979-85)

Over the next few years, the United States and the rest of the world will be fortunate to escape a second radical increase in world oil prices. The adjustment process would again be painful. Most of the energy-producing and energy-using equipment that will be important in that period is already in place.

Even with the benefits of last year's National Energy Act, imports are still unacceptably high, and without further action could be still higher by 1985.

> As an immediate objective, which will become even more important in the future, the Nation must reduce its dependence on foreign oil and its vulnerability to supply interruptions.

The challenge of the near term is to ensure that investments in new energy producing and consuming equipment are made in the degree and kind that reflect the new realities, and that existing stock and equipment are used in the most effective way.

Movement toward the pricing of oil and gas at their true replacement cost will prepare American consumers better for long-term price increases and stimulate greater production and conservation now. Removal of barriers to new production will eliminate excessive regulatory delays that now paralyze the construction of new refineries, pipelines, and other energy projects. Filling the Strategic Petroleum Reserve (SPR), diversification of world oil supplies, and other actions will cushion the economic impact of an interruption. All these measures can set the stage for actions that will buy even greater energy security in the mid-term.

The Mid-Term (1985-2000)

During the mid-term, the U.S. and the rest of the world will begin to shift from reliance on oil and gas to new and higher-cost forms of energy. Energy consumption growth should be far slower than once anticipated. Direct coal use, electricity and decentralized renewable sources will increase their share of the market. The uncertainties--especially those surrounding world oil supply and price--are much greater for the mid-term than for the near term. These uncertainties will give the U.S. a major opportunity to influence more directly its own energy future.

> In the mid-term, the Nation must seek to (1) keep imports sufficiently low to protect U.S. security and to extend the period before world oil demand reaches the limits of production capacity and (2) develop the capability to use new higher-priced ("backstop") technologies as world oil prices rise.

Because of the uncertainties in the mid-term outlook, the U.S. cannot afford to pursue an inflexible set of programs or actions. No one can be certain how fast or how slowly world oil prices will rise. The U.S. must press forward with those actions that are appropriate today. It should begin now to develop the capability to use new technologies that rely on domestic or non-OPEC resources, to be deployed if and only if they become competitive with imported oil at higher prices. Introduction of these advanced technologies also will require innovative solutions in design and deployment to ensure compatibility with environmental goals.

The Long Term (2000 and beyond)

The U.S. faces two major transitions in energy markets between now and the middle of the 21st century. The first will occur during the mid-term when the U.S. moves from an energy system which has depended on traditional oil and gas sources (including imports) to one relying on unconventional supplies. These "transitional" energy supplies include some renewable technologies, enhanced oil recovery, oil shale, unconventional gas, and coal-derived products.

Since even those supplies are depletable, a second transition will begin after the year 2000. A set of "ultimate" technologies, including all the renewable and advanced nuclear technologies, would begin to displace traditional fuels and non-renewable conventional sources.

> The Nation's long-term objective is to have renewable and essentially inexhaustible sources of energy to sustain a healthy economy.

Many promising technologies may prove excessively expensive. Environmental and safety problems may render others infeasible. There is always the danger that premature or overbearing Federal support for any one group of technologies may foreclose more attractive options. The current generation cannot and should not impose its own judgments and values on generations yet to come. The final choices about deployment of various technologies must be left to them.

A sustainable energy future cannot be achieved overnight. The U.S. cannot expect "crash" technological breakthroughs to solve its energy problems. The technical advances that do occur are best encouraged by diligent, aggressive research and development programs for the widest range of options.

AN AGENDA FOR ACTION

The Federal government, State and local governments, and the private sector all have important responsibilities to advance conservation and specific fuel technologies in all three time periods. This section describes Federal policies and programs.

Conservation

Conservation continues to offer the greatest prospect of reducing dependence on unstable imports, reducing energy costs, and meeting environmental goals. The objectives of the Administration's conservation policies are two: to reduce the rate of growth in demand for energy and to improve the productivity of energy use--by increasing the energy efficiency of existing and future capital stocks of buildings, vehicles, homes, and industrial operations while sustaining economic growth. The tools for achieving these objectives will be mainly the impact of higher energy prices, the conservation tax incentives in the Energy Tax Act, and regulatory measures.

- Conservation will be encouraged by policies for replacement-cost pricing, as embodied in the Natural Gas Policy Act, the phased decontrol of crude oil prices, and the Public Utilities Regulatory Policy Act.
- The residential and industrial conservation tax credits in the Energy Tax Act will be an important mechanism to encourage near-term energy conservation.
- Energy use in new buildings and appliances will be reduced by using the regulatory authorities in the Conservation Policy Act and other legislation. Energy use in automobiles will be regulated by fuel economy standards. The Administration will work to resolve promptly the issues surrounding future use of the diesel engine.

- Grants will continue to be provided to low income families, schools, and hospitals to improve the energy efficiency of residential and community facilities.
- The Administration will seek and exploit opportunities to demonstrate conservation and increased efficiency in energy use and productivity at the institutional and community level. Institutional barriers to greater conservation will be reduced by intervening in utility rate proceedings and by acquainting the public with opportunities to conserve.
- The Federal government will lead the way in energy conservation, starting with its own buildings, processes, and transportation.
- The Department of Energy will support research and development (R&D) to improve efficiency where the benefits of new developments will not be captured by industry without government involvement. Major RD&D targets include industrial operations, buildings, and new automotive propulsion systems.

Oil

Financial incentives and the reduction of institutional barriers are the major tools to raise oil production.

- Domestic production will be increased by rapidly phasing out controls on crude oil and, until complete decontrol in 1981, by providing price incentives targeted for production from new discoveries, marginal wells, and the use of enhanced oil recovery techniques.
- To prevent excessive revenues from flowing to producers in the wake of decontrol, the President has requested that the Congress enact a Windfall Profits Tax. Its proceeds would be used to help low-income families, to encourage mass transit, and to create an Energy Security Fund.
- Alaska and California production will be stimulated through steps to accelerate transportation systems to bring oil more cheaply from the West Coast to mid-Continent, Gulf, and East Coast markets. Exports or swaps of Alaskan oil are also under consideration as a way to strengthen markets for West Coast production.

- Oil Shale technology will be developed and tested on a commercial scale through a production tax credit financed by the Windfall Profits Tax.
- To provide security in the event of a possible disruption, the Strategic Petroleum Reserve will be filled, ultimately to a level of one billion barrels.
- Sources of production worldwide will be diversified. The Administration will support multilateral bank financing and other incentives for exploration, development, and production in less developed countries. The Administration will also encourage accelerated development of improved technologies for extraction of heavy oils and tar sands.

Natural Gas

The natural gas policy has two high priority elements--use of the temporary domestic surplus to substitute for oil imports and incentives to increase conventional domestic production.

- Domestic production will be encouraged by financial incentives, including the higher prices stemming from the recently enacted Natural Gas Policy Act; through a more stable and predictable regulatory environment; the deregulation of high-cost gas, most notably that below 15 thousand feet; and, deregulation on a predictable basis.
- Surplus gas and reasonably-priced supplemental sources of gas will be used to displace foreign oil in existing industrial and utility facilities capable of burning both oil and gas; coal will continue to be the preferred fuel for existing coal-capable units and all new boiler facilities.
- Supplemental sources of gas will be used in the order of their cost-effectiveness and security. Under present circumstances, the order of attractiveness is: Alaska production; pipeline gas from Canada and/or Mexico; short-haul liquefied natural gas (LNG); domestically produced synthetic gas, depending upon the resolution of certain technical problems and cost; and long-haul LNG.
- Financial incentives or R&D as appropriate will be used to quicken the production of unconventional sources of gas, including gas from tight sands, Devonian shale, geopressurized methane, and coal bed methane. R&D programs will be directed at determining the size of the resource base, the cost of extraction, and the possible environmental effects.

Coal

Coal, the Nation's most abundant fossil energy resource, should be used in place of oil and gas wherever economically and environmentally feasible. Programs that increase the use of coal as a substitute for oil will receive the highest priority.

o Direct Use

- The Powerplant and Industrial Fuel Use Act (PIFUA) will be used to require coal use in all new electric utilities and major industrial fuel burning installations, and in existing coal capable facilities;

- Research, development, and demonstration (RD&D) programs will be used to develop environmental control technologies and environmentally acceptable means of direct coal use to enhance the overall market for coal and to increase the regulatory options available under the PIFUA.

o Coal Liquefaction

- RD&D for direct coal liquefaction processes will be used to develop the capability by the 1990s for commercial deployment of plants producing the most economic synthetic liquid fuel.

- Indirect coal liquefaction processes based on existing technology will be examined to determine whether they offer additional economic or environmental benefits.

o Coal Gasification

- The Administration supports favorable rate treatment and loan guarantees for first-generation Lurgi technology.

- The two second-generation gasification technologies now being considered for demonstration will be developed and analyzed further, leading to a decision in early FY 1980 whether to proceed with a demonstration plant.

- Research and development on advanced technologies will be continued. Funding levels will be based on whether the processes appear to promise more economic and environmental benefits than available technologies, and on whether this supplemental source of gas is needed.

- **Improved Efficiency Coal Conversion**

  - R&D on advanced coal conversion systems such as magnetohydrodynamics (MHD), combined cycle, pressurized fluidized bed, and fuel cells will attempt to resolve key technical, economic, and environmental questions.

Nuclear

The Presidential Commission will provide a complete accounting of the causes of the Three Mile Island accident and its handling by utility, State, and Federal officials. The Nation needs to develop safeguards that will allow light water reactors to continue to meet an increasing share of electrical energy needs.

- **Light Water Reactor**

  - The Administration will work toward resolving nuclear waste management issues, including both away-from-reactor storage and permanent disposal, in accordance with the recommendations of the Interagency Review Group.

  - Nuclear siting and licensing legislation will be proposed to streamline procedures without in any way sacrificing the safety of new power plants.

  - Generic R&D will be undertaken to improve light water reactor (LWR) operations, to improve the safety of LWRs, and to improve their efficiency and thus extend the uranium resources they utilize.

  - Reliable and economic uranium enrichment services for domestic and foreign users will be assured by:

    - Operating and expanding the existing gaseous diffusion plant capacity.

    - Commercializing gas centrifuge technology by establishing a machine manufacturing industry and building a commercial centrifuge enrichment plant.

    - Developing advanced isotope separation enrichment technology.

- **Breeder Reactor**
  - R&D on breeder reactors will continue so that commercial development can be initiated, if justified by future market conditions and non-proliferation policies.
  - Breeder reactor demonstration will be deferred pending the results of the International Nuclear Fuel Cycle Evaluation and interagency review.
- **Fusion**
  - Research on the magnetic and inertial confinement concepts will continue with the objective of demonstrating scientific feasibility in the mid-1980s.
  - The program for development of fusion energy will be governed by a structure of sequential decision points to select candidate technologies and to initiate construction of large facilities. If all goes well, the first commercial use of fusion will occur in about the year 2020.

Renewable Energy Sources

The Nation's capacity to use renewable resources should be enhanced. The maturity of these technologies varies greatly; some are economic now, others are in the early stages of R&D. Federal support must be tailored to each stage of development.

- **Solar Energy**
  - Tax credits and other financial incentives will be used where necessary to accelerate market penetration of solar technologies that are economic or nearly economic now (solar hot water heating, certain industrial process heat systems, passive solar systems, direct wood burning, and low head hydro).
  - RD&D and/or product support will advance those technologies that have significant market potential and that replace oil and gas, but which are not yet competitive in the mass market (certain solar industrial process heat systems, active solar space heating, conversion of biomass to liquid and gaseous fuels, and wind systems).

  - R&D and limited product support will develop those technologies with significant long-term potential, but which are far from economic application (solar cooling, photovoltaics, solar thermal, and ocean thermal energy conversion (OTEC)).
  - The Administration will continue to study the possible applications of technologies with highly uncertain potential (solar power satellites, photo-chemical conversion).

- o Geothermal
  - Tax incentives and loan guarantees are the primary tools to encourage the use of hydrothermal resources. RD&D will be used where the technology has not been demonstrated.
  - Research and development will be used to develop the technology to use hot dry rock geothermal resources.
  - The Administration will encourage the development of geopressurized energy primarily as sources of methane and secondarily as sources of heat from hot water.

Cross-Cutting Policies

In addition to these programs designed to ameliorate the Nation's fundamental energy problems in future years, it is necessary to confront today's crises. The ways in which the Federal government deals with energy problems must be streamlined. And energy policy must treat all citizens fairly.

- o Dealing with the Current Crisis

  With conservation and other measures, the United States will meet its commitment, reached jointly with other member nations of the International Energy Agency, to cut energy consumption by 5 percent by the latter part of 1979.

- o Emergency Preparedness

  The Department of Energy, in cooperation with state and local governments, will continue to develop and refine planning and management capabilities to deal with emergency shortages of supply.

- **Management of Energy Processes**
  - The Administration will seek to clarify and simplify processes and procedures for siting and licensing new energy facilities, without sacrificing the opportunity to carefully balance conflicting policy objectives.
  - The Administration will work closely with States and local governments to ensure that they participate fully and effectively in developing and implementing the Nation's energy policies. The Administration has proposed the Energy Management Partnership Act to provide funds to accomplish this objective.

THE SIGNIFICANCE OF NEP-II

The actions already undertaken, and those currently proposed, will place the Nation's energy policy on a sound and long-lasting footing. Movement toward replacement cost pricing for crude oil, coupled with last year's action on natural gas pricing, will build a coherent economic framework for making more rational decisions about energy production and consumption--and thus about the Nation's energy future. These actions are coupled with a variety of measures, such as the Windfall Profits Tax, designed to assure equity for consumers.

By beginning to remove the roadblocks to timely and equitable decision-making on energy projects, the Nation can increase production of its domestic resources. By spurring the development of new technologies, the U.S. will lay the groundwork for their future use as world oil prices rise.

The decade of the 1960s, and the early 1970s, saw imports climb steadily, both in absolute terms and, more dangerously, as a percentage of total consumption. With each passing year, the Nation became more dependent on oil imports, and thus more vulnerable.

The National Energy Act, and the actions and proposals recently announced by the President, will arrest those trends. By 1985, the measures in the National Energy Act will reduce imports 2.5 to 3.0 million barrels per day below what they would have been without those actions. The additional steps proposed this year will save over one million barrels per day. As a result, oil imports are expected to drop as a percentage of total energy consumption by 1985. Although imports will still be comparable to current levels, U.S. vulnerability will be reduced substantially by the availability of the strategic petroleum reserve.

After the series of crises over the last few years, crises that resulted in shortages of oil, gas, and coal, it is now clear that it is impossible to lay out, in one document, all the policies that ultimately may prove necessary for the Nation's long-term future. Instead, NEP-II provides the Congress with the best information available at the present time with which to make future decisions, to deal with future developments, and to capitalize on future technological advances.

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CHAPTER I

CRISIS AND UNCERTAINTY IN THE WORLD ENERGY FUTURE

A. The Immediate Crisis and the Continuing Problem

During the past six years, the U.S. has faced a succession of energy crises. The OPEC embargo of 1973-74 ushered in an era of unstable energy supplies and much higher energy prices. Since 1974, the U.S. energy situation has continued to deteriorate. Energy consumption has risen steadily, but domestic production has remained almost stationary for a decade. The resulting "gap," filled by oil imports, has therefore widened. Indeed, despite the benefits of last year's energy legislation and the President's April 5 crude oil pricing decision, the U.S. is still likely to import about the same amount in 1985 as it does today. Without the National Energy Act and recent Presidential initiatives, however, the U.S. would likely demand imports of over 12 million barrels per day (MMBD) by 1985.[1]

Recent events in Iran have demonstrated once again the high cost of this U.S. dependence on unstable oil sources. For 69 days, from the end of December to March, essentially no oil was shipped out of Iran, which previously had supplied about ten percent of world oil production and about 18 percent of the oil in world trade. Stepped-up production by other OPEC countries, especially Saudi Arabia and Kuwait, made up for more than half the initial loss of 5 MMBD. The shortfall in the U.S. exceeded 500,000 barrels per day (or 2.6 percent of U.S. demand).

As the Iranian disruption makes clear, even a small oil shortfall can have immediate and severe economic consequences. On March 27, OPEC raised world oil prices by 9 percent, or $1.20 a barrel--applying immediately an increase scheduled to be phased in through 1979. OPEC members are also free to impose above this new floor price surcharges that could range between $2 and $4 a barrel. Prices in the "spot" market, where oil not under long-term contract is traded, recently soared to over $20 per barrel.

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[1] Oil production and consumption usually are measured in million barrels per day (MMBD). To place these figures in perspective, the United States in 1978 produced 10.3 MMBD (including natural gas liquids) and consumed 19.1 MMBD, the balance being made up primarily by imports. Worldwide, production was about 63 MMBD in 1978.

Events in Iran also proved how quickly a glut in world oil markets can turn into a shortage. The "excess" OPEC production capacity that existed in mid-1978 disappeared overnight when Iranian exports ceased. Apart from control of vast reserves, OPEC's continuing power derives from the pressure of growing world oil demand on limited production capacity. During the loss of Iranian production, only a few OPEC countries were able and willing to expand production significantly, much less close the gap that had been created.

OPEC producers have taken advantage of the tightening market. Before this year is over, world oil prices may have risen 20 percent or more above prices at the end of 1978; from these increases, U.S. gasoline prices could climb more than 8 cents a gallon at the pump. These oil price increases could be a serious drag on the U.S. economy in 1979 and 1980.

As Iranian production returns to about half its former level, the shortfall may continue. Saudi Arabia and Kuwait may cut back their stepped-up production in the coming months. If no actions are taken to reduce consumption and switch to alternative fuels, U.S. refiners may not be able to rebuild inventories adequately to meet next winter's heating demands.

This immediate shortfall risk and the potential reduction of long-term OPEC supply would raise serious concerns by themselves. But they are only symptoms of the broader energy problem the U.S. and the rest of the world now face.

First, the supply of oil available to the U.S. and the rest of the world is limited fundamentally by the production decisions of a few countries in which world oil resources are concentrated. This chapter discusses the strong likelihood that, sometime in the 1980s, OPEC and non-OPEC countries will be unwilling or unable to produce enough oil to match even a low rate of growth in world demand for their oil. World oil resources will be far from exhausted, but maximum oil production of these countries will be reached. Prices would have to increase sharply to bring oil demand in balance with supply. World oil prices could rise in real terms to as much as $25 to $30 per barrel by 1990. In 1990 prices, adjusted for future inflation, oil could be selling for $42 to $55 a barrel.

Second, the U.S. and other nations can anticipate potential instabilities and supply disruptions from the countries in which oil resources are concentrated. Future instabilities and curtailments -- each with its own price shocks and recessionary effects -- will have political and economic costs for the U.S. An energy strategy must seek to reduce both sets of costs as much as possible, and smooth the Nation's long-term adjustment to a world of increasingly scarce oil supplies.

The rest of this chapter describes how the U.S. became dependent so quickly on foreign oil, the costs of dependence to its economic security, the political risks, and the strategic dangers. It examines three different projections of world oil price behavior over the next twenty-five years. Each of these projections reflects different assumptions about how fast world oil prices will rise, what OPEC nations may produce, how much production from new discoveries will be needed, and other uncertainties. Finally, the chapter suggests that the Nation is likely to face serious risks to its economic and political security no matter what path world oil prices take.

B. The Emergence of the Energy Problem

THE U.S. BECOMES OIL-DEPENDENT

Before the OPEC price hike in late 1973 and 1974 and the financial and economic upheaval that followed, most Americans took for granted that cheap, abundant domestic energy would be always at hand. In the 25 years after World War II, the U.S. economy had grown to rely on massive quantities of domestic petroleum--at notably low prices. Indeed, real domestic energy costs fell by about 30 percent between 1950 and 1970 (Figure I-1). Spending on domestic energy production in itself became a major stimulus to economic growth.

Entire markets and industries--and an automobile-centered economy--were created by this flow of cheap energy. The nation's transportation system was built on a foundation of low oil prices. By 1970, the U.S. home heating market and U.S. industry derived three-quarters of their energy needs from oil and gas.

As early as the 1950s, however, a few petroleum geologists and economists started calling attention to the approaching depletion of cheap U.S. oil resources. Increases in domestic consumption began to outpace new discoveries. After 1961, U.S. proved reserves entered into a steady decline. The U.S. petroleum industry had never in its history been able to discover and produce oil at the rate it was being consumed by Americans in the 1960s and 1970s (See Figure I-2). The rapid rise in U.S. imports in the mid-1970s fully exposed the weakness of the Nation's petroleum resource position.

In the late 1960s, as world-wide demand for oil quickened and surplus world production capacity dwindled, OPEC began to sense its growing power. The heavy European and Japanese reliance on imported oil--and the newly emerging dependence of the United States--were not lost on

Figure I-1
Prices of Domestic Fossil Fuels
(In Constant Dollars)

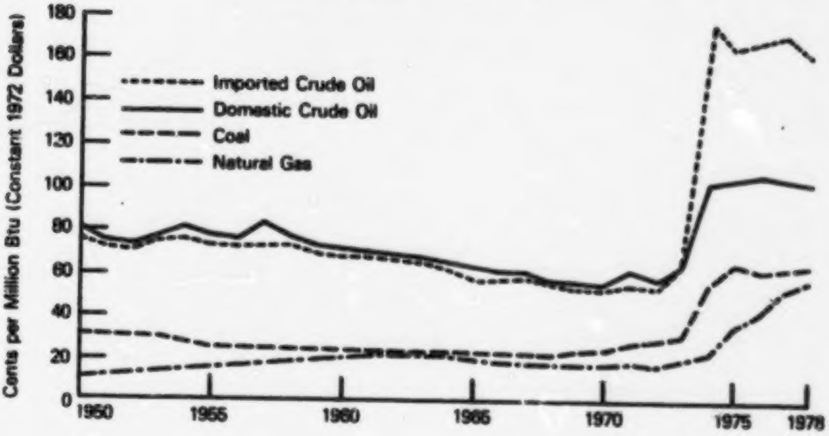
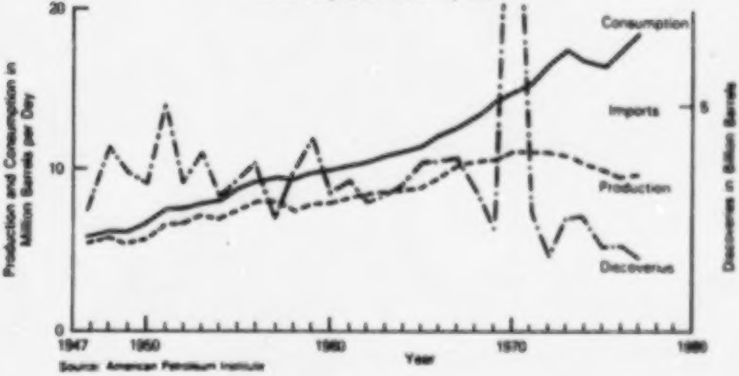


Figure I-2
Oil Discoveries, Production and Consumption
(Including Natural Gas Liquids)



Source: American Petroleum Institute

the cartel. The embargo of the winter of 1973-74 and the attendant production cutbacks led to the quadrupling of world oil prices and the transfer of pricing and production control from the international oil companies to the OPEC governments. A string of nationalizations ratified this shift in control.

Since 1973, the economic security of the industrialized world has hung on the decisions of a small cartel of producer nations. In the U.S., the adverse effects of the first OPEC price increase continued to spread throughout the economy as the U.S. consumed more imported oil at higher prices.

In spite of the OPEC price increase, domestic production of crude oil excluding natural gas liquids has actually declined--from 9.2 MMBD in 1970 to 8.7 MMBD in 1978--despite stepped-up drilling nationally and new oil from Alaska. Since 1970, the rates of discovery of new reserves and additions to supply have fallen to less than half the rate of domestic oil production. From 1970 to 1978, proved reserves in the lower 48 states diminished from 11 to only 7.5 times the amount of annual production, and 4.5 times the amount of annual consumption.

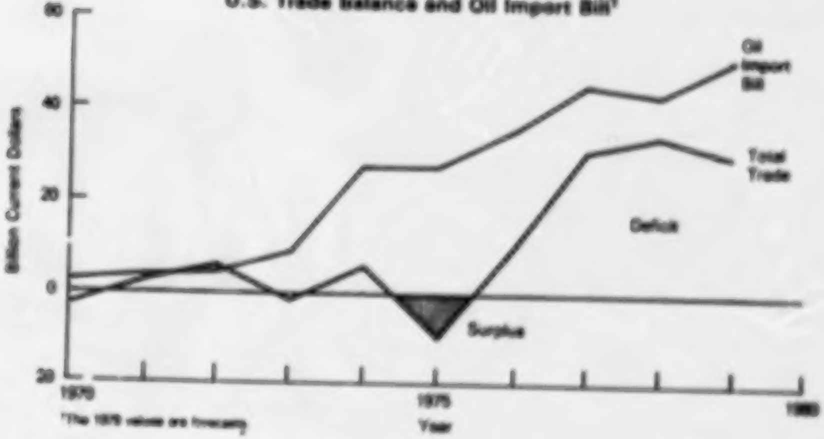
The increasing failure of domestic oil production to meet domestic oil demand is mirrored in the sharp rise of U.S. imports. In 1973, the U.S. imported 35 percent of its oil; by 1977, it was importing 48 percent. Even more disturbing from a strategic perspective, the U.S. has almost tripled its purchases from the Arab OPEC nations.

In 1978, oil imports slackened somewhat as oil from the North Slope of Alaska added 1.2 MMBD to domestic supply. However, this new supply is at best a temporary respite. Without the demand restraint measures taken to offset Iranian shortfalls, 1979 import levels would surpass those of 1977 and reach record highs--perhaps as much as 9 MMBD through this year.

The cost of the nation's rapid swing to imported oil has been substantial. The U.S. paid $4 billion for imports in 1971 and $8 billion in 1973. In 1977 and 1978, the U.S. paid $45 billion and $42 billion respectively. In 1979, with the surge in prices from the Iranian disruption, the total import bill could exceed $50 billion. (See Figure I-3).

Such gross measurements of the import problem, however, do not convey adequately the complex, painful adjustments that have been forced on the U.S. economy by its inability to meet traditional energy demands at traditional prices. A closer review of the period from 1973 through 1978 is necessary to show the impact on U.S. economic output, inflation, balance of trade and national security. The following discussion does that--and adds some perspective on the possible impacts of another large increase in world oil prices.

Figure I-3
U.S. Trade Balance and Oil Import Bill[1]



[1] The 1979 values are forecasts

THE TRADE IMBALANCE, THE DOLLAR CRISIS, AND INFLATION

The 1973-74 oil-price increases significantly sharpened the already severe U.S. recession in 1974 and added to inflation afterward. Table I-1 traces the drop in U.S. economic output linked to the OPEC price rise for each of the years from 1973 to 1977 (in 1972 dollars). Table I-1 also shows the inflation in the same period traceable to the OPEC price hike (as measured by the annual percentage increase in the Consumer Price Index (CPI)). Even before 1974, the U.S. economy had begun to suffer the unhappy combination of inflation and recession. The large oil price increase aggravated both problems simultaneously.

The 1973-74 price hike contributed to a recession by shifting income to OPEC that was not then available to be spent in the U.S. economy. Consumers had to pay more for the same amount of energy, which meant they had less to spend on other goods and services. Since energy demand is relatively fixed in the short run, consumers could not entirely avoid paying the higher energy costs by conserving fuel or by using substitutes for oil.

TABLE I-1

EFFECTS OF THE 1973-74 OIL PRICE INCREASES ON THE U.S. ECONOMY[1/]

	1973	1974	1975	1976	1977
Loss of Economic Output (GNP Loss in Billion 1972 Dollars)	--	38	63	41	40
(Percent Reduction)	--	3.1	5.2	3.2	3.0
Increased Rate of Inflation (Change in Consumer Price Index)	0.3	2.5	1.7	0.2	--
Increased Rate of Unemployment	0.1	0.7	1.7	0.5	--
Loss of Employment (thousand jobs lost)	84	600	1,450	500	--

[1/] Entries are the differences between actual performance of the economy and simulations of how the economy would have performed had world oil prices not increased. The simulations were performed using the Data Resources, Inc., econometric model and the Inter-industry Transactions Model developed by Edward Hudson and Dale Jorgenson.

Besides deepening the recession, the oil price increase brought more inflation, both directly and indirectly. Higher oil prices raised the cost of everything that used oil or an oil substitute. The reverberations of the price increases continued in the economy for two or three years after their initial impact.

The increased price for imported oil was also an indirect source of inflation. The sharp rise in oil prices, combined with greater dependence on imports, raised the bill for U.S. oil imports to new highs. When U.S. payments for non-oil imports also started to rise, the U.S. experienced disturbing trade deficits in 1977 and 1978. These deficits, combined with accelerating U.S. inflation and an economic expansion more rapid than that of America's trade partners, added to the excess supply of dollars in the world's foreign exchange markets, which in turn led to the depreciation of the dollar that began in mid-1977 and continued through most of 1978. An additional, closely-related influence may have been the expectation of many dollar holders that increasing oil imports would deepen the trade deficit and further depreciate the dollar.

Depreciation of the dollar raises the price of all imports and further abets inflation. The slide of the dollar raised the Consumer Price Index (CPI) about 0.4 percent in 1978. Even if the dollar's value remains stable in 1979, the 1978 depreciation will add about 0.8 percent to the CPI in 1979 as the delayed price impacts filter through the economy.

The most important economic effect of the 1973-74 price rise is the reduction in the U.S. standard of living from what it would have been with cheap foreign oil. Americans simply are not as well off when they have to exchange more U.S. goods and services for the same amount of imported oil.

The resulting economic problems would have been even worse if the cost of oil in real terms had not declined by about 12 percent from mid-1974 to the end of 1978. This period of grace, however, clearly seems to be over. Recent OPEC price increases to over $16 per barrel (including transportation cost to the U.S.), and the $2 to $4 surcharges that some OPEC members will charge, could be the harbinger of further large price increases if markets tighten in the future.

THE SECURITY THREAT

The dangers to U.S. political security under the present world oil supply system are in some cases obvious; in other cases, they are subtle. Above all, U.S. economic activity now depends on maintaining month-to-month the delicate links to oil supplies from volatile and potentially unstable areas in the Middle East and North Africa.

Interrupted Supplies. Events such as revolutions, wars, politically inspired embargoes, strikes, sabotage and other upheavals jeopardize American oil supplies. Some countries in the Middle East and North Africa have political systems that have been highly susceptible to political and religious conflict in recent years. Even Iran, which many had regarded as stable, fell into political chaos during 1978.

Production decisions in such oil producing countries often can become embroiled in civil strife or be used to pursue foreign policy goals. Domestic turmoil such as Iran's can disrupt supplies for an indefinite period. Or new militant regimes can come to power, seeking to broaden their support with defiant gestures aimed at the West. The strong U.S. support of Israel has been a separate and long-festering source of discontent among many Islamic OPEC countries.

During the 1970s, the U.S. began to take steps to limit its vulnerability to these external dangers. The Strategic Petroleum Reserve (SPR)--which the U.S. initiated only late in 1976--is designed to build a buffer stock of oil to cushion the damage from supply interruptions and to discourage their use as political tools. However, a long and major OPEC supply interruption ultimately would damage the U.S., given the limited capability for "surge" production in the rest of the world.

Furthermore, a politically-motivated embargo aimed at the U.S. would inevitably affect Japan and Western Europe as well, perhaps even more seriously than here. Through the International Energy Agency, the major consuming nations of the world have agreed to share equitably the supplies available in the event of a major disruption. Even if the U.S. were relatively self-sufficient in energy, it would remain strategically vulnerable to supply disruptions because of its political, economic and military interdependence with Japan and Western Europe, both of which remain heavily dependent on imported oil.

The Politics of Oil. The evolution of strategic relations in the Middle East, especially the security of the Persian Gulf, has become a pre-eminent concern of U.S. policy. More than 60 percent of the oil in world trade now passes down from the Persian Gulf through the Straits of Hormuz. Guarantees for the security of that oil will remain extremely critical to the U.S. and its allies through the foreseeable future.

The world energy situation also is likely to increase the importance of the Soviet Union in world oil and gas markets--whether as an importer or exporter. Western Europe has begun to turn to the Soviet Union for natural gas. Meanwhile, Communist-bloc countries may place new demands on OPEC supplies as the Soviet Union reserves more of its production for domestic use.

Meanwhile, America's heavy consumption of oil--which now accounts for nearly 40 percent of non-Communist world production--may seriously strain its present alliances. Consuming nations have sometimes complained that the inability of the U.S. to curb its appetite for imported oil is jeopardizing their own economic security.

C. The Uncertainties of the World Energy Future

In recent years, there has been a flood of expert pronouncements on the U.S. and the world's energy future. These predictions often reflect the bias of the forecaster and have tended to increase public scepticism and confusion about the energy problem. The simple truth is that no one can predict or "prove" what the world's energy future will be. Any such forecast relies on assumptions about demand, supply or government policies that are subject to vast uncertainties.

While no one can predict the future, it is possible, indeed necessary, to identify certain credible scenarios for future world supply and demand. In this report, three world oil price cases are presented. These cases are merely abstractions for planning purposes. They are simplifications of real world behavior, meant to show how world oil prices would behave for different assumptions about supply, demand, and government policies.

Analysis of these different futures lends support for two basic principles in the design of an energy strategy. First, the U.S. must plan for a range of contingencies, from pessimistic to optimistic. Second, and perhaps less immediately obvious, none of the futures considered here is necessarily "better" than another. The debate between the price optimists and pessimists in this country has been somewhat beside the point. Each price case has its own disturbing implications, whether it be for economic growth and stability, U.S. vulnerability to recurring supply interruptions such as Iran's, or long-term U.S. political security. The U.S. must address in each case what premium or cost it should pay to limit the potential economic damage and insecurities from oil imports.

Table I-2 summarizes five major factors that will shape the U.S. and the world energy future: economic growth and world oil demand, OPEC production potential, non-OPEC supplies, Communist-bloc needs, and the price of unconventional energy sources that can substitute for petroleum fuels. This table describes three sets of assumptions for these

TABLE I-2

ASSUMPTIONS USED TO DETERMINE WORLD OIL PRICE PATHS

Assumptions	Cases[1] High Demand/ Low Supply	Mid-Demand/ Mid-Supply	Low Demand/ High Supply
Free World Oil Demand (Percent Increase per Year)			
1980-90 average	4.0	3.4	2.5
OPEC Production Potential (MMBD)			
1985	32	36	41[2]
1990	32	39	44[2]
Supply Available from Countries Outside OPEC (MMBD)			
1985	22	25	28
1990	24	27	31
Net Oil Imports of Communist Economies (MMBD)			
1985	+2.5	0	-1
Price for Unconventional Substitutes (1979 dollars per barrel)	38	32	27
CORRESPONDING PRICE CASE	HIGH PRICES	MEDIUM PRICES	LOW PRICES

MMBD = Million Barrels per day.

[1] The supply and demand assumptions used here presume that world oil prices will be held constant. The price analysis then uses these assumptions as a starting point to generate oil price trajectories that change oil demand and supply to bring about a balanced oil market. All supply estimates include natural gas liquids.

[2] These supply assumptions give the technical limits on maximum OPEC capacity, which in the low price case would not be reached due to the low growth in world demand.

factors that underlie the projections for low, medium, and high world oil price behavior. Government policies and technological innovations will influence strongly what happens to each of the five major factors in the world energy future.

WORLD OIL DEMAND AND ECONOMIC GROWTH

There are three major influences on future world oil demand--world economic growth, the relationship between energy use and economic output, and the energy demand met from fuels other than petroleum.

Since 1973, the world's economic growth rate has slackened, and most forecasts for both U.S. and world economic growth are now more pessimistic. For the forseeable future, the average rate of economic growth is expected to remain below pre-1973 levels--mainly because of slower population growth, declining productivity increases, inflation, and higher real energy costs. A likely range for world economic growth through 1990 is 3.5 to 4.5 percent a year.

The relationship of energy use to economic output, or the amount of energy needed to produce an additional unit of Gross National Product (GNP), has varied over time. In the 1960s, world energy demand rose at the same rate as world economic growth. Since 1973, however, world energy demand has risen slower than world economic growth, mainly because of conservation and fuel switching brought on by the OPEC price increase and subsequent government actions. The outlook for the ratio of energy use to GNP varies from country to country. It is too early to say whether or how much the ratio may continue to drop world-wide. Depending on future energy prices, a reasonable range for the ratio is about 0.7 to 0.9--that is, energy use would grow only 70 to 90 percent as fast as economic output.

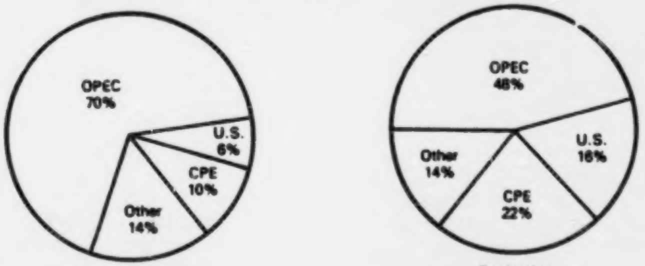
Finally, world oil demand will depend on the amount of world energy demand satisfied by non-petroleum fuels. Country-by-country, there will be significant variations in the domestic production of these non-petroleum fuels, which include natural gas, coal, nuclear power, and renewables. A large world trade could develop in natural gas and possibly coal. In general, non-petroleum fuel production should increase at about 3.5 percent a year between now and 1990.

If these estimates are accurate and real world oil prices were held constant, growth in world oil demand would range between 2.5 percent and 4.0 percent annually through 1990.

WORLD OIL PRODUCTION

OPEC Production. During the current crisis, OPEC has been producing about 31 MMBD--over half the world's total (Figure I- 4).

Figure I-4
World Shares of Oil Reserves and Production, 1978



Proved Reserves
657 Billion Barrels

Production
63 Million Barrels per Day

CPE = Centrally planned economies.
OPEC = Organization of Petroleum Exporting Countries.
Source: Central Intelligence Agency

The outlook for OPEC production in the long-term is clouded not only by the uncertain future production policies of Iran, but also by the policies of the other OPEC members. With vigorous investment, and if the new Iranian government were willing and able to restore production close to pre-crisis levels, OPEC could technically raise sustainable production to 41 MMBD by 1985.

OPEC producers, however, are almost certain not to develop their fields to the maximum technical limit of production. By 1985, OPEC is most likely to be producing about 36 MMBD, with Saudi Arabia the major swing producer. OPEC may hold production below the maximum technical ceiling because member countries wish to prevent possible damage to oil fields, to conserve oil and stretch out their oil revenues, or to slow the pace of internal development programs that have absorbed so much of these revenues in the past. Such restraint also reduces the risk to OPEC that its production would peak and decline after large investments had been made to reach maximum capacity.

For these and other political or economic reasons, OPEC might restrict production to about 32 MMBD. The lower the ceiling on OPEC production, the sooner world oil prices could begin to rise in real terms.

Non-OPEC Supplies. With extensive exploration, non-OPEC proved reserves will continue to rise. Production from non-OPEC nations should range between 22 and 26 MMBD by 1985, and may rise to 24 to 31 MMBD by 1990, with expanded production from Mexico, the North Sea, Alaska, and other regions.

While the world still has vast oil resources, much greater exploration will be needed just to maintain the rates of new additions to proved reserves experienced in the past decade. More and more new discoveries have come in Arctic and oceanic regions, requiring arduous, high-cost drilling activity. The costs of production and transportation for North Sea or Alaskan oil, for example, outstrip by several multiples the equivalent costs for Persian Gulf or North Africa reserves.

Future discoveries of large fields -- especially the "super-giant" fields that in the past have yielded most of the world's oil supply -- will almost surely decline sharply. If this occurs, it will be necessary to produce unprecedented volumes of oil from smaller-than-average finds in more difficult and forbidding environments. In some cases, the small size of these discoveries will not justify the higher costs and risks of production, even at increased world oil prices.

Furthermore, the discovery and development of large new fields (if they are to be found) will probably take about a decade, and production may not be timely to prevent sharply rising prices. For some Arctic and offshore regions, the technology for production might not even be ready before the 1990s. Over the next 10 years, therefore, the world's oil supply is likely to come almost entirely from known and still-to-be-discovered fields in the world's currently producing oil provinces.

A final major uncertainty in non-OPEC production is Mexico. Oil resources in Mexico seem sufficient to support a high level of production. However, significant technical, social and economic problems would arise with a rapid expansion of production. While Mexican production and export policies beyond 1982 are yet unformulated, the International Energy Agency has projected that Mexico's exports may be no more than 3 to 4 MMBD by 1990.

Communist-Nation Supplies. Communist nations have so far been net suppliers to the world market, exporting about 1 MMBD, mainly to Western Europe. While this situation may continue, it is also possible that several Eastern European countries will become net importers in the future. China, on the other hand, may emerge as a significant exporter of oil. The most pessimistic estimate of Communist-nation import needs is 2.5 MMBD by 1985.

Unconventional Substitutes. Liquid fuels from coal, oil shale, heavy oils, and other sources have the potential to substitute for oil and hold down rising oil prices. To date, however, there have been few attempts to produce such liquid fuels commercially. The lead times for commercial production could range from 5 to 15 years, once the decision to produce had been made. Even if the price of oil jumped suddenly to

$30 a barrel or more, it still would take many years to generate enough supplies of these oil substitutes to have any substantial impact on world oil price levels.

To sum up, government decisions in both OPEC and non-OPEC countries will have a decisive influence on the supplies available to meet future world oil demand. Regulatory and tax policies, investments in new productive capacity, application of enhanced recovery techniques to existing fields, and expanded exploration programs will strongly affect the timing and behavior of future oil price increases. Foresight in developing oil substitutes from unconventional sources also will be crucial in moderating oil price increases once they begin.

D. World Oil Prices

Figure I-5 shows high, medium, and low world oil price "paths" that reflect the different sets of assumptions in Table I-2. The prices shown in this Figure and the companion Table I-3 are useful chiefly for long-term planning. They are not predictions, and therefore should not be the basis for specific contingency plans. Surprises and crises are almost certain to occur, affecting the timing of a price increase and disrupting any smoothly rising price path.

Figure I-5
Three Paths for World Oil Prices
(1979 Dollars per Barrel)

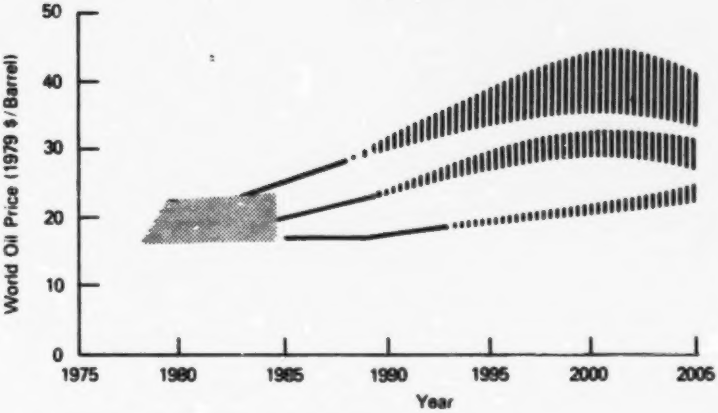


TABLE I-3

WORLD OIL PRICE PROJECTIONS[1]

Prices Measured in 1979 Dollars

Price Cases	1985	1990	2000
High	25	30	38
Medium	20	23	32
Low	16	17	21

Prices in Inflation-Adjusted Dollars
(Assuming Inflation of 5.5 Percent Annually)

Price Cases	1985	1990	2000
High	35	55	120
Medium	28	42	100
Low	22	30	67

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[1] Projections indicate the average U.S. refiner acquistion costs for crude petroleum imports at the given date.

TIMING OF A PRICE INCREASE

The Iranian situation dominates the short-term world oil price outlook. If Iran restores production to 3 or 4 MMBD and other OPEC countries maintain most or all of their stepped-up production, the pressure for large price increases in the immediate future could diminish. In Figure I-5, the shaded area for world oil prices between 1979 and 1985 reflects this near-term uncertainty.

But even with the prompt and full return of Iran's exports, oil prices are likely to rise during the next decade. The pressures on limited production capacity during this period will be decisive. Table I-3 predicts that prices could increase to $25 per barrel by 1985, up to $30 by 1990, and up to $38 by the end of the century (in 1979 dollars). In 1990 prices, adjusted upward by 5.5 percent a year for inflation, oil could be selling for $55 per barrel in that year. With the same type of price adjustments, oil could cost between $65 and $120 per barrel by 2000.

LONG-TERM PRICE BEHAVIOR

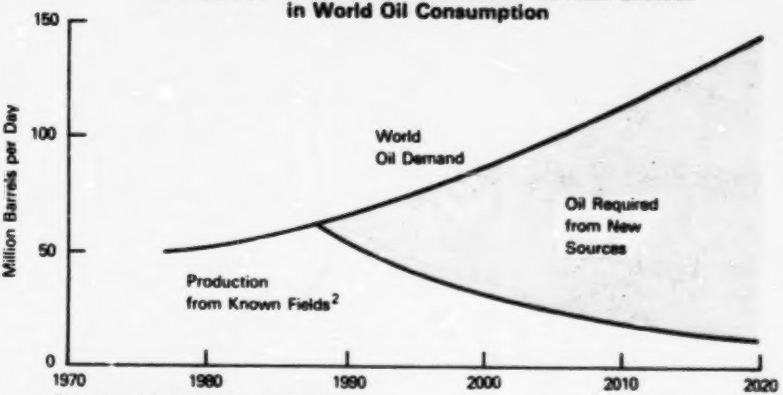
The long-term behavior of world oil prices will hinge primarily on two factors -- the rate of discovery and development of new oil sources and the price at which unconventional energy technologies can compete with and substitute for petroleum fuels.

Figure I-6 shows the tremendous amount of new oil that would be required to meet even the low growth rate of 2.5 percent annually in world oil consumption. Even if large new fields can be discovered and developed by the early 1990s, the incremental production from such fields would be swallowed up quickly by demand growth as production from currently known fields declines.

By 1990 the world would need to produce 10 MMBD from new discoveries to supplement declining production levels from known fields. By 2000, it would need to produce a remarkable 40 MMBD more than that. New discoveries and additions to supply would have to surpass anything ever before experienced to meet even a small growth in world demand.

While new discoveries are unlikely to be adequate to keep prices from rising, unconventional substitutes could meet a growing portion of the world oil demand, as shown in Figure I-6. The decline in production from known oil fields and the discoveries of new oil sources will influence how quickly such fuels (unconventional oils, coal liquids, and others) are called into use. Extra investment in these technologies now could prevent a scramble to develop supplies on a crash basis

Figure I-6
Oil Required To Maintain a 2.5 Percent Annual Growth in World Oil Consumption



[1] Does not include centrally planned economies.
[2] Assumes 600 billion barrels of known reserves and a 5 percent per year decline in production from developed fields.

later when prices begin to rise. Greater certainty about the price at which unconventional fuels become competitive might even deter some OPEC price increases in the first instance. It could also reduce the risk that world oil prices will "overshoot," or temporarily exceed, their long-term level.

An analysis of world oil prices suggests a final observation. Policies that attempt to hold prices artificially low in the near-term--for example, price regulation--are likely to push prices up more rapidly in the long-term. Artificially low near-term prices for oil will not only quicken world oil demand, but also slow the development of alternative supplies. Eventually the underlying pressures will prevail and prices would have to rise abruptly to balance demand with supply.

E. Consequences for the U.S.

Even if one assumes smoothly rising prices, without another disastrous price jump such as occurred in 1973-74, each price path shown in Figure I-5 indicates potential difficulties for the U.S.--either with oil import levels and payments, or impacts on economic growth and inflation. For comparative purposes, Table I-4 summarizes the different projected impacts of these "planning cases."

IMPORT LEVELS: THE MEASURE OF VULNERABILITY

The energy legislation enacted by Congress last year should cut oil imports by about 2.5 MMBD from levels projected for 1985. The President's recent oil pricing decision should reduce imports by another one MMBD by 1985. Despite these gains, Table I-4 shows that oil imports in 1985 will remain at about the same level as the current import demand.

The early 1980s will be the period of greatest vulnerability to supply interruptions--while the U.S. continues to fill the Strategic Petroleum Reserve. The Reserve will contain 750 million barrels by 1986. The full measure of protection--1 billion barrels--will not be available until later.

The low and medium world oil price paths imply longer continued U.S. vulnerability to embargoes and disruptions, with imports reaching 11-13 MMBD by 1995 in the low price case. When coupled with the President's program of oil price decontrol, the high price path will lead to significant import reductions, with oil imports dropping as low as 4-6 MMBD by 1995. As Chapter II makes clear, U.S. oil imports could rise in all three cases if domestic energy supplies, especially coal and nuclear power, experience major regulatory or other non-price barriers. In such a "worst case," U.S. oil imports by 1990 could rise above 10 MMBD with medium world oil prices.

The projections assume that, after 2000, investments in new technologies will begin to cut into import levels for all three price cases. Imports could be anywhere from 5 to 13 MMBD by the year 2000, depending on the behavior of world oil prices.

IMPORT COSTS: THE POTENTIAL RISKS TO TRADE BALANCE

U.S. oil import consumption in all three of these scenarios will translate into persistent, large import bills that range from $45 billion to $90 billion a year (in 1979 dollars) through the end of the century. For the high price path, the import bill levels off at $65-$75 billion by 1990. For the medium price path, the oil import bill continues to increase to $75-$80 billion in 1995.

Table I-4 indicates that the import bills for the different price cases will not differ markedly until the early 1990s; the greater price for each barrel of oil in the high price case is roughly offset by a reduction in the amount of oil imported. In all three cases, large periodic jumps in price triggered by supply interruptions or other events could cause the import bills to fluctuate and increase the risks of dollar depreciation and inflation.

TABLE I-4

ECONOMIC IMPACTS OF HIGHER WORLD OIL PRICES ON OIL IMPORTS, COSTS OF IMPORTS, ECONOMIC OUTPUT AND INFLATION

	1978	1985	1990	1995
Oil Imports (million barrels per day)	8.1			
Low Prices		8-9	9-10	11-13
Medium Prices		8-9	8-9	8-9
High Prices		7-8	6-7	4-6
Import Bill (billion 1979 dollars)	42			
Low prices		45-50	55-60	75-80
Medium Prices		60-65	65-75	80-90
High Prices		60-75	65-75	55-80
Annual GNP Loss[1/] (billions 1979 dollars)				
Medium Price Case Compared with Low Price Case		2-6	30-60	50-100
High Price Case Compared with Low Price Case		30-35	70-120	100-190
Inflation (percent increase in CPI)				
Medium Price Case Compared with Low Price Case		-	.3	.2
High Price Case Compared with Low Price Case		.5	.6	.3

1/ Figure shows the change in the value relative to the low price case.

Note: Estimates include the effect of the National Energy Act passed in October, 1978. 1979 dollars assumed equal to 1.074 times 1978 dollars.

Source: Simulations done by Scientific Time Sharing Corporation using the Data Resources, Inc. macroeconomic model and by the Brookhaven National Laboratories/Dale Jorgenson Associates energy-economy modeling system.

IMPACTS ON ECONOMIC GROWTH AND INFLATION

Table I-4 also shows how high oil prices over the long run would slow economic growth and bring more inflation. By 1990, if oil prices follow the high rather than the low price path, the Nation's economic output may be diminished by $70 billion to $120 billion a year (in 1979 dollar values). By 1995, the annual value of this lost output may be $100 billion to $190 billion, or a reduction of the Nation's potential GNP by 2.5 to 5.0 percent.

By 1995, the high price case also could raise the rate of change of the Consumer Price Index by three-tenths of a percentage point above the level that would prevail for the low oil price case. These estimates are predicated on gradual price increases. But prices might rise abruptly at some point in the future, as they did in 1973-74, or supplies might be interrupted. The shock of such abrupt changes could have wrenching short-run effects on economic activity. A rapid oil price increase would leave the economy little time to adjust to the higher energy prices and higher prices for goods and services overall. If combined with other adverse economic conditions, such a price increase might well push the economy into a serious recession, and expand the total economic damage.

This discussion has concentrated on the economic loss from the high price case in contrast to the low price case. Without doubt, lower world oil prices bring economic benefits. However, lower prices will lead to more oil imports, and comparatively greater U.S. vunerability to supply disruptions from countries in which world oil resources are concentrated. These costs are not as measurable or as predictable as those pictured in Table I-4, but they could be much greater.

Finally, it is useful to recognize that an important assumption behind the low price case is an extremely low rate of world economic growth. With the close ties between the U.S. economy and the rest of the world's, such a poor economic performance is likely to affect U.S. economic growth as well. Stagnation and economic deterioration, here or abroad, are grim and unacceptable "solutions" to the world energy problem.

F. Conclusion

Three general themes have emerged from this brief review of the U.S. and world energy future.

First, the U.S. now imports large quantities of oil from potentially unstable supply sources. This continued dependence raises a host of political and economic security problems, and may complicate efforts to maintain the trade balance with stable exchange rates. The vulnerability to interruptions and sudden price increases is clear.

Second, it is likely that well before the turn of the century fundamental supply and demand forces will cause world oil prices to rise significantly faster than inflation. All three long-term projections of world oil prices--which assume no Iran-type disruptions--imply some combination of problems from a large price rise, especially a lower long-term rate of economic growth. Not only would world oil prices rise, but so would the costs of domestic energy supplies that compete with imported oil. The Nation's economy may have to shoulder an ever-growing burden of high energy costs to sustain and expand its economic output.

Third, a responsible energy strategy must seek to hold down the economic and political costs to the U.S. and its citizens during this transition to a world of scarcer, more expensive energy supplies. Serious problems could emerge in any of the energy futures discussed here, and must be anticipated. At home, uncertainties other than world oil price and supply could keep domestic energy production from reaching its full potential and could increase oil import levels at a time of rising prices.

U.S. political and economic security are vulnerable to small swings in world oil production and consumption. The future of the American economy can depend on the policies of a few producer states, or on political contingencies that the producer states themselves cannot always control. At the same time, the U.S. and other consuming nations face a new period of long-term price rises, slower growth, faster inflation, and periodic supply interruptions. Fortunately, the U.S. is not helpless against these dangers, but it must have a coherent energy strategy to protect its security.

CHAPTER II

THE U.S. ENERGY FUTURE: THE IMPLICATIONS FOR POLICY

An energy strategy must seek to balance those measures that improve the Nation's long-run security and those that better prepare it to deal with sudden crises. With the recent National Energy Act of 1978 and the President's decision on oil pricing, the U.S. can gradually reduce the percentage of imported oil in its supply picture. Future demand growth can be met with coal, nuclear power, solar and unconventional technologies.

Unlike the forecasts in the first National Energy Plan, the projections in this chapter for U.S. production and consumption have assumed a range of possible world oil futures, which are reflected in three oil price paths. These projections also reflect the effects of last year's energy legislation and implementation of the President's recent oil pricing and other proposals. The impacts of these proposals will be described in detail in Chapter VIII.

These projections are not meant to be predictions of the future; in particular, they do not assume major unexpected constraints on any domestic supply source--especially nuclear power or coal. Should such constraints occur, the Nation's dependence on imports could rise dramatically.

A. The Near Term

OUTLOOK

Over the next seven years (1979 - 1985), the U.S. and the rest of the world will be fortunate to escape a second radical increase in world oil prices. If prices should rise significantly, the adjustment process would again be painful, for the U.S. can do little to influence oil supply and demand in the near term.

Since the first National Energy Plan, the U.S. has continued to demonstrate that it can sustain economic growth with much less energy than had been thought necessary. On the production side, however, recent experience has not been encouraging. Coal production by 1985 will fall short of the goal sought in the first Plan. Almost no new orders have been placed for nuclear power plants since 1975, and projections of future nuclear capacity have been revised sharply downward. New finds from exploratory drilling for new oil sources, both onshore and offshore, have been disappointing. In response to the new oil pricing decision and the NEA, however, both oil and natural gas production will be larger than forecasted a few years ago; these are the major bright spots in the Nation's energy supply picture. Yet even with higher oil and gas prices, production of these two sources is not likely to increase in absolute terms much above the peak production levels of the early 1970s.

U.S. Consumption and Imports

In the last five years, Americans have begun to eliminate waste and increase the productivity of the U.S. energy system. For the past few decades, energy demand has increased generally at the same rate as economic activity, as measured by the Gross National Product (GNP). From 1975 to the present, however, energy demand has increased only 65 percent as fast as GNP. By getting more from the energy it uses, the Nation can maintain an expanding, dynamic economy with energy growth far below that predicted a few years ago.

Energy conservation is no longer synonymous with curtailment and belt-tightening. Americans have found ample opportunities for productive conservation since the first major OPEC price hike in 1973. Homes have been insulated, cars get higher mileage, and large energy savings have been realized by industry. The average fuel efficiency of a new car under EPA tests has risen from 14 miles per gallon in 1974 to more than 19 miles per gallon in the 1979 model year.

If world oil prices hold constant, U.S. primary energy demand should increase at about 2.1 percent annually through 1985. Such a rate would be close to the 2.0 percent sought in the first National Energy Plan, and much lower than the 2.8 percent that would have occurred without last year's National Energy Act.

Just a few years ago, such low rates of energy growth would not have seemed feasible. Between 1950 and 1973, U.S. primary energy consumption grew at a rate of 3.4 percent annually. During the 1960s, this rate was as high as 4.2 percent, and it was expected then that the U.S. would have to double or even triple its energy consumption by 2000.

The improvements in energy efficiency that can be made in the near term are limited, however. Many of the easier conservation actions have already been taken in response to the quadrupling of prices after the

1973-1974 embargo. In the future, substantial energy will be saved by gradually replacing the Nation's stock of buildings, cars, appliances, and industrial plants--a process which takes decades. More cost-effective conservation will be possible by better design and construction of new energy-using products rather than by retrofitting those that already exist.

Figure 1 shows that despite this lower energy growth, the "import gap" between U.S. energy consumption and domestic production will continue in the near term. If imports measure the nation's vulnerability to supply disruptions and price increases, then U.S. vulnerability will remain high. Indeed, if controls on oil prices were continued, demand for imports would be likely to rise from 8 MMBD in 1978 to as high as 10 MMBD by 1985. Decontrol of domestic oil prices could reduce import levels to as low as 8 MMBD by 1985.

U.S. Production

One major cause of the worsening import gap since 1971 is obvious--static production in the face of rising demand. While domestic production of energy has remained frozen near 60 quadrillion Btus (quads)* for almost a decade, U.S. energy consumption has risen by 13 quads in the same period. Conventional oil production has been falling since 1970, despite the four-fold increase in world oil prices in 1973-74. Production in the lower 48 will fall even further during the near term, but its decline will be offset by more expensive Alaskan oil from frontier regions and new oil from enhanced recovery processes. Total domestic production of oil, therefore, should stabilize roughly at the current level of about 10 to 11 MMBD.

During the near term, the domestic oil outlook will be greatly improved by the President's oil pricing decision. Newly discovered oil, enhanced oil recovery, and production from "marginal" wells will receive special-incentive prices after June 1, 1979. All controls on domestic crude oil will be phased out by September 30, 1981. By that year, oil import savings will be close to 400,000 barrels per day. By 1985, or the end of the near-term, import savings will be about one million barrels per day. The increase in domestic production alone could be roughly 750,000 barrels per day above levels that would have otherwise occurred with continued controls.

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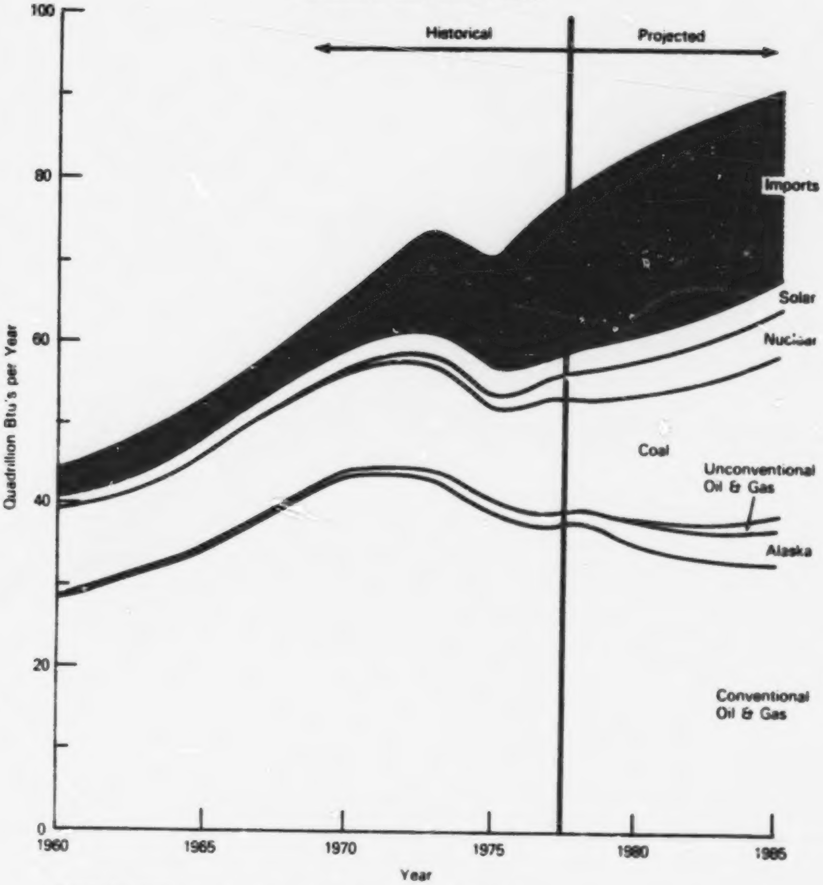
*In order to compare different kinds of energy, consumption often is measured in British thermal units, or Btus. A Btu is the heat required to raise the temperature of one pound of water one degree Fahrenheit.

Figure II-1
U.S. Energy Consumption in the Near-Term
(Medium World Oil Price Case)



With the President's program, imports remain near current levels in the Near Term

As the U.S. moves to solve the West Coast oil "glut," Alaskan North Slope oil could make a greater contribution. These projections assume that North Slope production will reach 1.5 million barrels per day by 1985. With construction of new west-to-east oil pipelines and other measures, production from the North Slope could increase by an additional 200,000 to 300,000 barrels per day.

Enhanced oil recovery, with appropriate incentives, could contribute as much as .5 to 1 MMBD by 1985, and help forestall a decline in total U.S. oil production. Oil shale, coal liquids, and other unconventional oil substitutes will make only a minimal contribution during this period. Planning in the near term, however, will be essential to bring these supplies on as world oil prices begin to make them economic.

The market for natural gas is likely to move from chronic shortage to balance in the near-term. The Natural Gas Policy Act of 1978 (NGPA) eliminated the distinction between the intrastate market and the price-controlled interstate market. In doing so, the Act made available immediately about 1 trillion cubic feet (TCF) of surplus gas that had been withheld from the interstate market. Higher prices, a more stable regulatory environment, and phased deregulation should raise conventional production above levels that would have occurred under previous law. Significant supplemental sources of gas could also materialize in the near term--Alaskan gas, pipeline imports from Mexico and Canada, synthetic gas from coal, LNG imports from a variety of sources, and unconventional domestic gas sources. Because the potential for these sources is uncertain, total supplies (including imports) could range from 20 to 22 TCF annually by 1985.

Coal production should rise from 660 million tons a year in 1978 to about 1 billion tons by 1985. Any slippage from this 6 percent annual increase in production could cause oil imports to balloon. The problems with coal are primarily problems of using coal, not producing it.

Current and prospective air quality standards, railroad rate regulations, and surface mining standards all raise a host of cost questions and other uncertainties that may inhibit increased investment in coal-fired facilities. The Powerplant and Industrial Fuel Use Act of 1978 will force industrial users in particular to look hard at coal and other fuels to burn in new boilers--instead of oil and gas. PIFUA and other legislation recently enacted provides a framework for moving forward with coal development and use in an environmentally sound manner. While significant progress has been made in implementing those laws, problems have emerged that could inhibit the attractiveness of coal. The Administration is committed to addressing these problems through careful monitoring of regulations and their economic and environmental impacts, and through research on new emission-control and coal-using technologies.

The accident at the Three Mile Island nuclear plant has intensified concern about the safety of nuclear power, and confused the outlook for further expansion. Unresolved problems of licensing and waste disposal continue to plague the industry. Schedules for additions of new capacity have slipped significantly over the last three years. Nuclear generating capacity could expand from its current 13 percent share of total electricity to 20 percent by 1985. Such an increase, however, would come from plants already under construction.

Renewable sources will not be of significant help in the near term, despite their critical importance over the long-term. Some renewable technologies, such as solar hot-water systems and passive solar space conditioning, are competitive today, especially against electric heating systems. Hydroelectric power, another form of solar energy, already accounts for about three quads of primary energy annually. Various "low-head" hydroelectric projects at existing small dams throughout the country and geothermal projects at geothermal sites could add regionally significant amounts of electricity by 1985. In general, however, solar's contribution in the near term will be hampered by the slow turnover in the existing stock of buildings, limited public understanding of solar energy's potential, and the marginal or unfavorable economics of most new solar technologies.

TOWARD A NEAR TERM STRATEGY

- As an immediate objective, the Nation must reduce its dependence on foreign oil and its vulnerability to supply interruptions.

In the near term, the U.S. can anticipate continued insecurities from supply disruptions and price shocks. However, by 1985, with implementation of the President's oil pricing decision, oil imports should be no higher than they are currently. Maintenance of this level would represent a marked improvement in the Nation's energy situation, since oil imports would account for a steadily declining share of U.S. energy consumption.

The President's decision has ensured that by 1981 all domestic oil will be priced at its true "replacement cost", the cost of using every additional barrel of imported oil to fill the U.S. oil supply gap. With the phase-out of price controls, market forces should lead naturally by themselves to more investments in conservation and production. The first task of the near-term strategy is to ensure that such investments are made.

As the Nation moves toward more realistic energy pricing, however, it must be careful to address the equity and welfare impacts of higher energy prices. A major purpose of the proposed Windfall Profits Tax is to assure that a substantial portion of increased producer revenues will be captured for the American public. The proposed Energy Security Fund will assist those families for whom the burden will be the heaviest.

Second, the strategy should seek to eliminate excessive regulatory delays and needless institutional barriers that have paralyzed construction of refineries, pipelines, and other energy facilities. This should include doing away with unnecessary delays in building nuclear power plants without sacrificing our commitment to the safety of new nuclear facilities.

Meanwhile, uncertainty about current and prospective air quality standards have also dimmed the attractiveness of coal. Government must continue to work towards stable environmental rules and work with industry to develop a number of emission-control technologies that can meet the new standards.

Third, the strategy should encourage investments in upgraded refinery capacity, to prevent shortages of unleaded gasoline and other petroleum products that are most in demand. Also, through regulatory incentives, it should encourage enhanced oil recovery processes to get higher yields from existing fields.

Finally, since near-term domestic production cannot displace imports altogether, the U.S. should seek to diversify world oil supplies and enhance their security of supply. The U.S. should support multilateral assistance to increase production in non-OPEC countries, and encourage immediate efforts to assess the potential oil resources that various non-OPEC countries possess.

The U.S. can also enhance the security of its supply with the Strategic Petroleum Reserve (SPR). A billion-barrel reserve, ultimately will have the capability of replacing all the oil denied the U.S. during all but the most severe embargoes and short-term interruptions. It would allow the Nation time to resolve the problems causing the embargo while postponing the economic distress that would arise immediately from a large oil shortage. By delaying the economic effects of any intentional disruption, the SPR can serve as a powerful strategic deterrent.

Finally, the United States has assumed a strong leadership role within the International Energy Agency (IEA) to encourage joint action to reduce overall energy demand and vulnerability in the near term and mid-term.

The measures described here not only constitute a balanced near-term strategy, but also set the stage for policies that buy even greater energy security in the mid-term. Movement toward replacement cost pricing in the near-term will call forth greater production of conventional energy supplies. This enhanced production, in turn, will allow more time to develop new and unconventional energy technologies that can substitute for oil and help hold world oil prices in check.

B. The Mid-Term

OUTLOOK

During the mid-term, the world is likely to begin an epochal shift away from its historic reliance on conventional oil and gas. The uncertainties in the world energy picture, therefore, will intensify dramatically. The world oil price, in particular, will have much greater impact on U.S. production and demand growth than it had in the near term. All three of the oil price projections indicate that world oil demand will probably exceed production capacity some time during this period. As noted in Chapter I, world oil prices may not rise in a smooth or predictable way, but with abrupt, damaging shocks.

The different price cases considered in this analysis form an "envelope" that puts some bounds on the uncertainties in the world oil market. Each of the price cases, however, represents a particular set of dangers for the U.S. Even with decontrol of domestic oil prices, U.S. import dependence will remain significant for a time in all three price cases during the mid-term. If world oil prices are low, imports could climb to 13 MMBD or higher by the year 2000. In the low price case, imports would stay roughly at current levels for a time, held down by the President's recent oil pricing decision and the measures enacted in the National Energy Act. Imports would begin to rise, however, by the end of the mid-term period. (See Table II-1).

Table II-1. PRIMARY ENERGY SUPPLY IN THE YEAR 2000

Effect of World Oil Prices[1]
(Quads per year)

		Year 2000 Projections		
	1977	Low Prices	Medium Prices	High Prices
DOMESTIC PRODUCTION				
Crude Oil & NGL	20	20	21	22
Natural Gas	19	18	18	19
Coal[2]	14	33	36	39
Nuclear	3	15	16	17
Hydro, Solar & Geothermal[3]	4	9	10	10
TOTAL PRODUCTION	60	95	100	106
IMPORTS				
Oil	18	27	18	10
Gas	1	2	2	2
TOTAL IMPORTS	19	29	20	12
TOTAL CONSUMPTION[4]	78	123	119	117

Effect of Supply and Demand Uncertainties
(Quads per year)

		Year 2000 Projections		
	Medium World Oil Price Case	Low Nuclear[5]	Low Coal & Nuclear[6]	Low Demand[7]
DOMESTIC PRODUCTION				
Crude Oil & NGL	21	21	21	21
Natural Gas	18	18	18	17
Coal[2]	36	38	25	28
Nuclear	16	9	10	13
Hydro, Solar & Geothermal[3]	10	11	14	9
TOTAL PRODUCTION	100	98	89	88
IMPORTS				
Oil	18	19	23	15
Gas	2	2	2	1
TOTAL IMPORTS	20	21	25	16
TOTAL CONSUMPTION[4]	119	118	113	103

NOTES TO TABLE II-1

1/ Assumes the three world oil price cases discussed in Chapter I. Totals may not add due to rounding.

2/ Net of approximately 2 quads of coal produced domestically and exported.

3/ Includes 1.8 quads of decentralized biomass currently unaccounted for in DOE statistics. These balances account for decentralized solar as end-use quads displaced. For example, in the medium price case, 3 quads of decentralized solar penetration represent 4.3 quads of primary energy displaced. The medium price case, therefore, represents 11 quads of primary solar and geothermal energy in 2000.

4/ Net of approximately 1 quad of refinery and other losses.

5/ Assumes a moratorium on new construction of nuclear plants. Nuclear capacity reaches 150 Gwe by the year 2000.

6/ Assumes stricter environmental standards, high coal technology costs, and higher coal supply costs in addition to a moratorium on nuclear construction.

7/ Potential GNP is decreased .6 percent per year below the base case (from 3.1 to 2.5 percent per year, 1978-2000).

If world oil prices are high, imports could decline to about 5 MMBD by the year 2000, as more domestic energy supply becomes competitive with oil at the higher prices. However, the large rise in the world oil price that leads to such a drop in imports would be extremely damaging to the U.S. economy, resulting in a cumulative loss in GNP of $700 billion by 1995 compared to the low world oil price case.

In general, though, under the President's program, U.S. imports will probably account for a diminishing share of the Nation's energy consumption during the mid-term. Only in the low price case would imports maintain even their current share of consumption. Such outcomes are not assured, however; the U.S. would consume more imported oil in a "low nuclear" future, in which no additional nuclear plants were built except those already under construction. Oil imports in 2000 could be 3 to 4 MMBD higher than projected if severe constraints were clamped on both coal and nuclear power.

On the other hand, Table II-1 also indicates that a slow-down in U.S. economic growth could lead to lower projected U.S. oil import levels. A reduction of about one-half percent below the projected U.S. economic growth of 3 percent a year would reduce imports from 9 MMBD to 7 MMBD in the medium price case.

U.S. Energy Demand

During the mid-term period, total U.S. energy demand is not likely to increase at the rate that was once anticipated. Mid-term economic growth will be lower, probably falling to an average 2.9 percent a year, compared with 3.5 percent in the 1978-85 period (see Table II-2). The projections in Table II-1 indicate that, by the end of the century, total U.S. primary energy consumption (including conversion losses) will rise from 78 quads per year currently to about 120 quads in the medium price case. These projections include a great deal of conservation and thus are far lower than estimates in the late 1960s that predicted the U.S. would require 200 to 240 quads annually by the turn of the century.

As shown in Table II-1, the variation in total primary U.S. energy consumption due to different world oil prices is surprisingly small. End-use consumption, however, is reduced significantly with higher prices, as shown in Table II-3. Higher oil prices discourage overall consumption but encourage more use of electricity and other "energy-intensive" fuels, which lose more energy in conversion to delivered forms.

TABLE II-2

ECONOMIC GROWTH AND ENERGY EFFICIENCY
(Medium World Oil Price Case)

	1950-73	Near Term 1978-85	Mid-Term 1985-2000	Average 1978-2000
Growth in Gross National Product (percent per year)	3.6	3.5	2.9	3.1
Growth in Energy Consumption (percent per year)	3.4	2.1	1.8	1.9
Ratio of Energy Consumption Growth to GNP Growth	.94	.6-.7	.5-.6	.55-.65

Table II-3. END-USE ENERGY CONSUMPTION IN THE YEAR 2000

By Fuel
(Quads/year)

	1977	World Oil Price Case: Low	Medium	High
End-Use Consumption[1]				
Liquids	33	42	35	29
Gases	17	21	22	22
Direct Coal	4	9	9	9
Electricity	7	13	14	15
Renewables[2]	2	4	5	5
Subtotal	62	90	85	80
Conversion Losses	16	33	35	37
Total Consumption	78	123	119	117

By Source
(percent)

	1977	World Oil Price Case: Low	Medium	High
End-Use Consumption				
Liquids	53	46	41	35
Gases	27	24	26	28
Direct Coal	6	10	11	12
Electricity	11	15	17	19
Renewables	3	5	5	6
Subtotal	100	100	100	100

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[1] Fuels delivered to consumers in their final energy forms, excluding the losses in converting one energy form to another (e.g., coal to electricty or synfuels).

[2] Including 1.8 quads of end-use biomass not currently accounted for in Department of Energy statistics.

Total primary U.S. consumption will vary more directly with the rate of U.S. economic growth and the effectiveness of conservation measures. A difference of only one-half percent in this growth rate can add or subtract about 15 quads from projected energy consumption in 2000 (Table II-1).

Besides lower economic growth, the other driving force behind the drop in projected consumption is the increased productivity of energy. The rate of growth in energy demand should be only about 2 percent annually --half the rate of demand growth experienced in the 1960s. Primary energy demand should not only rise more slowly, but also stay well below the rate of U.S. economic growth, as Table II-2 indicates.

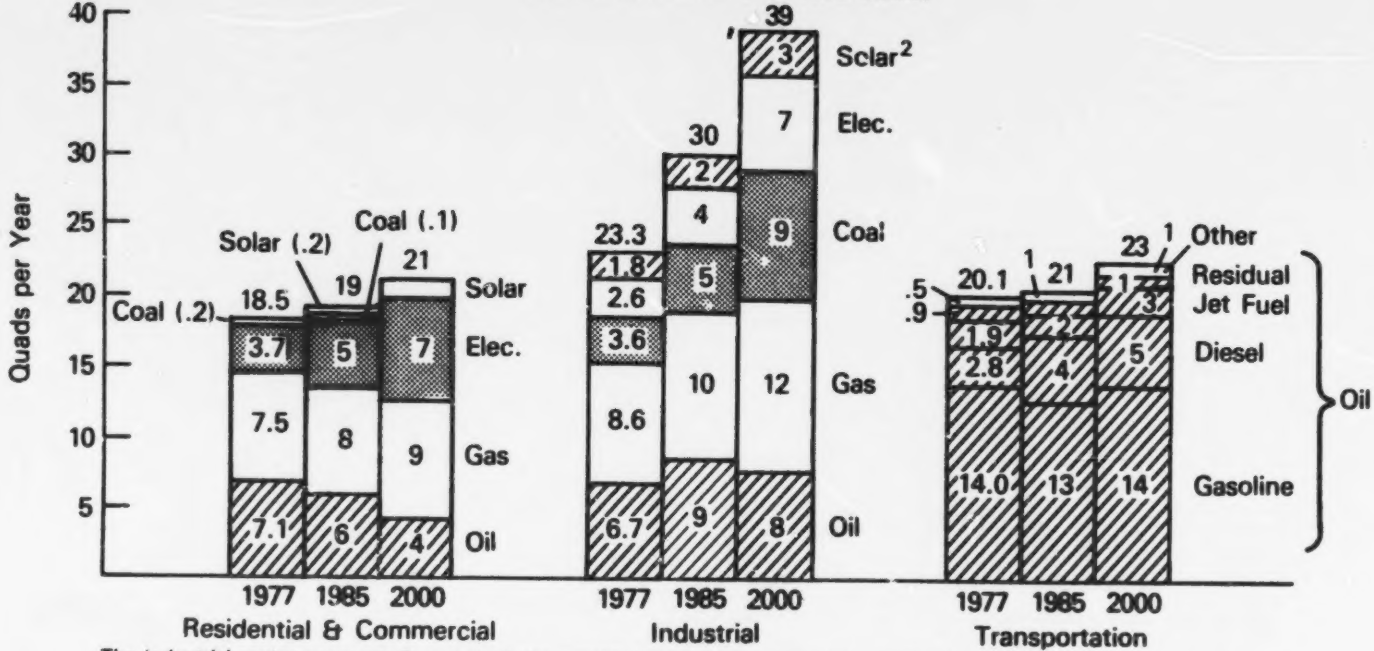
During the mid-term, more energy-efficient cars, appliances, and buildings will replace the existing stocks. Most of the moderation in demand will stem from the introduction of vastly improved energy-using systems and equipment. The greater use of electricity and synthetic fuels to meet consumption growth will increase the conversion losses in the Nation's energy production and offset these improvements somewhat.

In addition, while the efficiency of energy use will increase, so will the total demand for energy as the economy itself expands. U.S. industry will consume greater amounts of energy over the mid-term than any other sector (see Figure II-2). Energy use in industry will rise 45 percent between 1978 and 2000, although energy use will grow scarcely at all in the transportation and residential-commercial sectors. Electricity and direct coal use will capture most of this new industrial demand. Energy consumption in machinery-intensive industries that require electricity is likely to grow at a rate faster than industrial consumption generally. Electricity use could increase from its current 10 percent to about 17 percent of industrial energy consumption by 2000. Coal used for boilers and non-boiler industrial processes will increase from its current 12 percent to about 23 percent of industrial consumption by 2000.

The exact mix of electricity, direct coal use, oil, and natural gas in the industrial sector for the year 2000 is not easy to forecast. Some of the new electricity will come from cogeneration, rather than central-station generation; since it is on-site production, it would be attributed to direct coal use rather than electricity. Natural gas use in industry will depend on the difference in the delivered prices of oil and gas--which will reflect the extent to which industry bears the incrementally higher price for new gas supplies under the Natural Gas Policy Act. Electricity use will depend heavily on the costs and availability of oil and natural gas.

67

Figure II-2
End-Use Energy Consumption by Sector and Fuel Type[1]
(Medium World Oil Price Case)



The industrial sector accounts for most of the growth in end-use energy consumption in the mid-term.

[1] Totals may not add due to rounding. [2] Includes 1.8 quads of biomass.

Energy consumption in residences and commercial buildings will increase only slightly. With retrofits and improved design and construction, the Nation's stock of buildings will become much more energy-efficient. However, the size of this building stock will grow in absolute terms in response to increased population and economic growth, and so will the overall energy requirements for this sector. The increased use of electricity for appliances, air conditioning in existing homes, and new home heating will offset some of the conservation improvements in the sector.

Finally, the transportation sector will retain its almost total dependence on petroleum-based fuels. Higher world oil prices probably will have little effect on the total amount of travel Americans undertake--especially personal travel by automobile--since fuel cost as a percentage of total transportation cost is still surprisingly small. Higher oil prices and Federal regulations, however, will stimulate continued improvements in vehicle efficiency. Americans will travel farther on less fuel, and total consumption of energy in this sector will remain about the same.

While it may seem an impressive drop from earlier forecasts, the U.S. still is projected to need an unprecedented 120 quads of energy a year by 2000, and more thereafter. The increased productivity of energy is unquestionably crucial to the Nation's energy future. But the economy will grow, too, and so will the urgent need for adequate energy supplies to meet this projected consumption.

U.S. Fuel Consumption in the Mid-Term

During the mid-term, significant changes will occur in the mix of fuels that American consumers use. Liquid fuels and natural gas will no longer be cheap and readily available. While in 1978 they met 80 percent of U.S. end-use energy demand, their combined share should drop to 60 or 70 percent by the year 2000. (See Table II-3).

The projections for end-use consumption of liquid fuels cover an unusually large range. Consumption might be from 21 to 14 MMBD, as world oil prices move from the low to the high end of the range. At a price between $25 to $35 per barrel, oil will begin to lose its traditional attractions and consumers will begin to shift to other energy forms. The mid-range projection for end-use liquid fuel consumption in 2000--18 MMBD--would be slightly above current end-use consumption.

To meet future demand growth, the Nation will reverse the trend toward increasing dependence on liquid fuels and gases. Natural gas will do little more than maintain its existing market share, or even drop slightly. By contrast, direct coal use, electricity and decentralized renewable sources will increase their share of the market.

The increased use of electricity in the mid-term means that much more of the Nation's future energy supply will be lost in conversion to the fuel forms consumers use directly. The conversion losses shown in Table II-3 measure the difference between the total energy inputs used and the energy finally consumed in delivered form. Final or end-use consumption is likely to rise from 60 quads a year currently to only 80 or 90 quads in 2000--30 to 40 quads below projected primary consumption. End-use consumption will grow at a rate much slower than primary consumption--an average 1.4 percent a year in the medium price case, compared with 1.9 percent a year for primary consumption.

Liquid Fuels

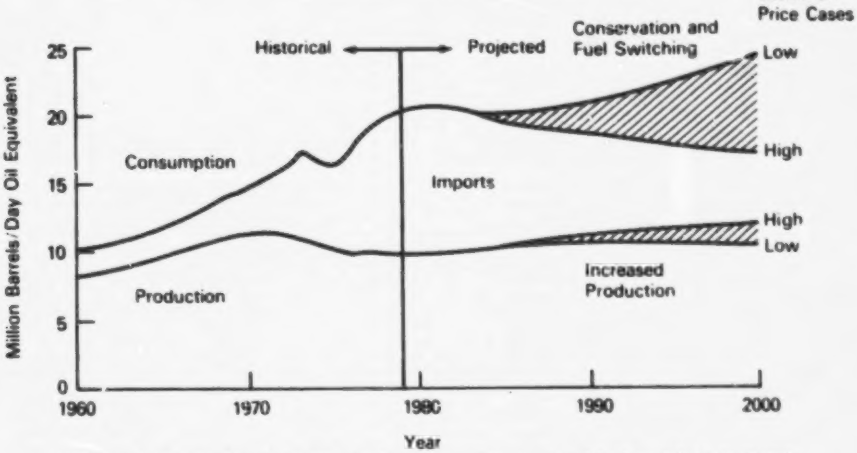
The supply and demand for liquid fuels--including crude oil, shale, and synthetic liquids--will be strongly affected by the President's recent oil pricing decision. By 1981, domestic oil prices would rise with world oil prices. With the upward movement in world oil prices, Figure II-3 shows there will be large and significant changes in the domestic oil market. First, as a result of the oil pricing policy, U.S. consumers will shift more quickly away from oil to other forms of energy as world oil prices rise. Figure II-3 indicates that, after 1985, fuel-switching and conservation probably will account for greater import savings than will increased production.

In addition, the incentives from the oil pricing decision are expected to be powerful enough to stem the decline in U.S. oil production that otherwise would occur during the mid-term. Conventional oil production in the lower 48 states would still fall slowly through the period. But as Figure II-3 shows, total U.S. production of liquid fuels could begin to increase slightly by the end of the mid-term, if world oil prices rise dramatically.

The principal source of new liquid fuel production will be enhanced oil recovery (EOR) from existing fields. At present, normal oil recovery operations yield about 1 barrel for every 3 barrels of oil actually in place under the ground. By the year 2000, EOR production in the U.S. could range from 2 to 3 MMBD. Synthetic liquids will contribute about 0.3 to 1 MMBD in 2000, making only a small contribution near the end of

Figure II-3

U.S. Oil Production and Consumption in the Mid-Term



High world oil prices reduce imports through conservation and fuel switching (reduced demand), and increased production.

the period. Oil shale, while faced with environmental constraints, could contribute up to 1 MMBD in 2000.

With higher world prices, U.S. liquid fuel production in 2000 could reach 12 MMBD, or 3 MMBD higher than in the low price case. With this additional production, almost all of which comes from unconventional liquids, U.S. oil imports in 2000 would fall to about 4 to 5 MMBD.

Natural Gas

The Natural Gas Policy Act (NGPA) provides the point of departure for analysis of natural gas production in the mid-term. With its schedule of real price increases and deregulated pricing for high-cost supplies, producers have a firm planning horizon through 1985 for developing conventional and unconventional supplies. After 1985, supply and demand should reach a balance, making most curtailments unnecessary during the mid-term. And despite higher prices, gas will still be competitive with most alternatives in the mid-term. Total U.S. consumption of gas should remain stable--between 18 to 22 trillion cubic feet (TCF) annually.

Prior to enactment of the NGPA, many had believed that U.S. proved reserves could guarantee only 10 more years of significant production. The view that gas was a quickly wasting resource failed to take account of large potential reserves below 15,000 feet and in marginal areas, which would become economic at higher prices. The recently enacted NGPA has brightened the prospects for production from these sources, ensuring considerable future drilling activity by the gas industry. Despite the potential of these new sources, however, lower-48 conventional production will probably continue to fall to 13 TCF annually by 2000, about half the amount when gas production peaked at 22.5 TCF in 1973.

One highly appealing source of supplemental gas supplies is Alaska. The Alaskan gas pipeline would not only guarantee long-term supplies from Prudhoe Bay, but also give access to other large gas finds anticipated in this region. With a possible 30 to 50 year operating life for this pipeline, potentially vast domestic resources of gas could be tapped and transported to the lower 48 states well into the 21st century, reducing the need for less secure and possibly more expensive foreign gas.

Other high priority sources of supplemental gas are Canada and Mexico. The U.S. already imports almost 1 TCF per year from Canada, and when the Alaskan gas pipeline is finished, these imports may jump substantially. Mexico's increased oil production also has opened up large quantities of natural gas. Both countries have a strong interest in negotiating a price for the gas that will create a stable long-term U.S. market.

The unconventional gases--geopressurized methane, Devonian shale, coal bed methane, and gas from "tight sands"--have a resource base in the U.S. at least 15 times greater than conventional gas resources. These supplies will be the "wild card" in the mid-term gas supply picture. By the year 2000, they could contribute as much as 4-5 TCF of production annually. The volume of such gas that can be sold with production costs of $2 to $4 per thousand cubic feet will determine the supply that will be forthcoming from these sources.

Electricity

Between now and 2000, prices will rise sharply for gas, oil and coal in that order, with a more moderate increase in the price of electricity.

Driven mainly by large capital costs, the price of electricity does not rise significantly with world oil price increases. As world oil prices climb higher, American consumers will tend to substitute more electricity for oil.

On the other hand, electricity use also tends to drop off sharply with a downturn in the economy. Economic expansion leads to faster growth or turnover in energy-using capital stocks, which provides the new demand for electricity use. The expected slowdown in U.S. economic growth in the mid-term will restrain the expansion of the energy-consuming sectors, and thereby limit the growth in total U.S. electricity demand. The projections for electricity use in Table II-3 are significantly below forecasts a decade ago--and below some forecasts still offered by the utility industry.

With high world oil prices, electricity would sustain its highest growth rate--4.6 percent a year average to 1985 and 3.6 percent to 2000. With low world oil prices, fuel-switching from oil would decline, and electricity use would increase by only 4.3 percent per year to 1985 and 3.1 percent to 2000. If nuclear power is not an available option in the mid term, however, electricity use cannot grow as fast as these projections assume.

These projections presume that coal and nuclear will share the bulk of the new capacity constructed between now and 2000. By then, their combined share of the fuels used to generate electricity should rise from 60 percent currently to about 80 percent.

Oil and gas use will become steadily less important. The Powerplant and Industrial Fuel Use Act of 1978 (PIFUA) prohibits construction of new baseload oil and gas facilities, and the Department of Energy intends to allow as few exemptions as possible. Oil and gas use in intermediate and peaking facilities will be phased out as these plants are retired. By 2000, oil and gas will account for less than 10 percent of the fuel used to generate electricity. High world oil prices could force early retirement of these plants in many areas, reducing this amount to minimal levels.

If nuclear power is not an available option, however, the U.S. cannot rely on coal by itself to make up the difference. In such an event, the disruption to the Nation's energy situation will depend on the timing and extent of the constraint placed on nuclear power. By 1985, nuclear plants now under construction could account for almost 20 percent of total electric generating capacity. If that capacity were removed from use altogether within the next few years, the U.S. would experience a damaging rise in oil imports to operate inefficient turbine plants and would risk periodic "brownouts" in many areas from lack of adequate generating capacity.

In the absence of nuclear power, it is highly doubtful that over the long run enough coal-fired plants can be built to meet projected electricity consumption. Coal-fired plants already are somewhat more expensive than nuclear power in many regions. In many cases, new coal-fired plants can be flexibly sited outside the "non-attainment" air quality regions. However, as more such plants are built, there will be fewer areas left where additional plants can be sited. At some point, there will probably be a ceiling on the amount of coal-fired power that can be substituted for nuclear electricity.

Coal

For almost any plausible energy future, coal must begin to realize its potential in the mid-term. Despite its problems, it remains a cheap, abundant, and versatile fuel compared to any other mid-term energy sources. As oil prices rise, it can capture an increasing share of industrial energy growth and electricity generation. It will also supply the raw material for synthetic liquid fuels that will be needed as direct petroleum substitutes.

If improved emission control technologies can be developed, the projections in Table II-4 indicate that strong pressures will be put on the coal industry's productive capacity. In the medium price case, U.S. production of coal would rise from 1 billion tons in 1985 to 1.7 billion in 2000. Coal production, therefore, must almost triple from its current (1978) level of 660 million tons.

Table II-4 projects total coal production and consumption in 2000 for each world oil price case. In the medium price case, about 25 percent of that year's coal production would satisfy industrial demand. About 60 percent would go to generate electric power. Only 10 percent would be used for manufacturing synthetic fuels, which will not become generally economic until the end of the mid-term period.

TABLE II-4.

COAL PRODUCTION AND CONSUMPTION IN THE YEAR 2000
(Million Tons Per Year[1])

		World Oil Price Cases		
	1978	Low	Medium	High
Consumtion				
Direct Use (Industrial)	150	400	405	410
Electricity Generation	470	915	1,000	1,075
Synfuels	--	130	185	240
Subtotal	620	1,445	1,590	1,725
Exports	40	110	110	110
Total Production	660	1,555	1,700	1,835

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[1] Ton-equivalents, converted at 22.5 million BTU per ton.

Solar and Geothermal Energy

If oil prices reach $32 a barrel by 2000, the market penetration of various solar and geothermal energy technologies should double from 4.8 quads in 1978 to about 11 primary quads displaced.[1] This projection includes about 6 quads from decentralized solar energy systems--including direct use of biomass products, passive solar uses, active space heating and cooling, and industrial and agricultural process heat. The emerging use of solar technologies in the industrial sector may be especially significant in the mid-term.

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[1] Including 1.8 quads from forest byproducts consumed by the pulp and paper industry.

Electricity from biomass, wind machines integrated into utility systems, and low-head hydroelectric installations could add markedly to electricity generation in the mid-term. Coupled with large hydropower and geothermal sources, renewable sources will generate almost 5 quads of electricity in 2000. Although an attractive technology in the long term, the current high costs of electricity from solar photovoltaic systems will have to be lowered significantly for such systems to have commercial potential in the mid-term.

Backstop Technologies

During the mid term, the serious energy challenge will come less from new demand growth than from the dwindling production of conventional fuels and the increase in world oil prices. The U.S. and other nations must turn increasingly to unconventional oil substitutes rather than expensive imported oil to meet the widening gap between conventional energy supplies and projected demand.

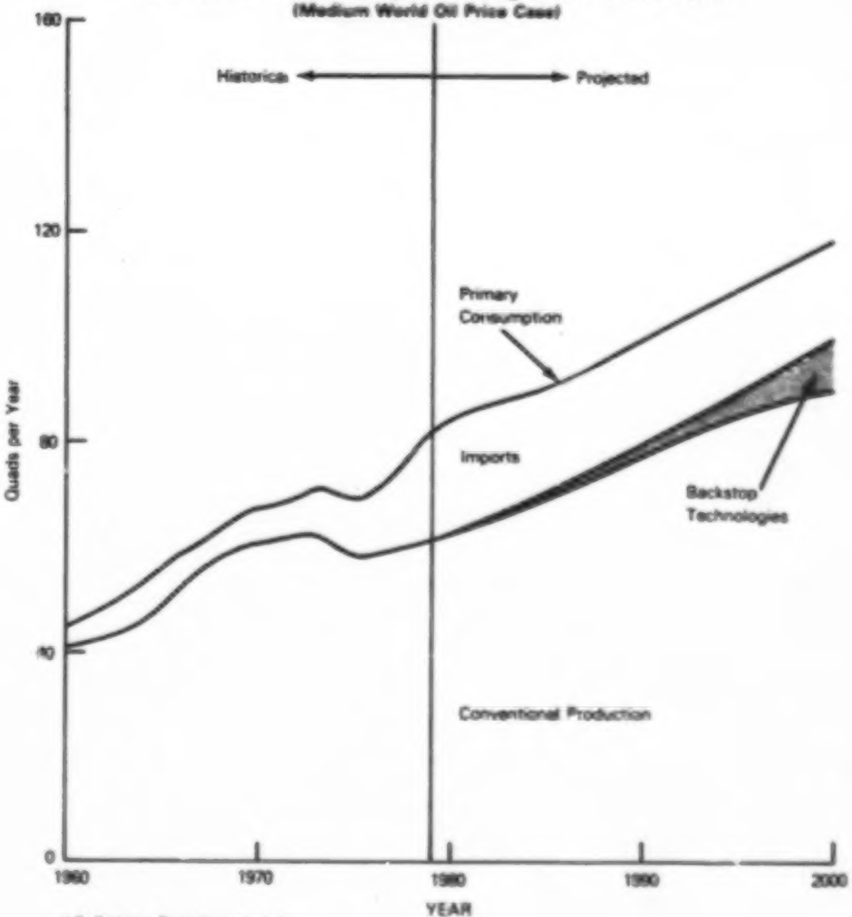
The new unconventional energy supplies include direct petroleum substitutes, such as heavy oils, tar sands, and synthetic liquids. If available in sufficient quantities, these substitutes could help hold down world oil prices. The new supplies shown in Figure II-4 also include the unconventional gases and solar technologies. Although these cannot substitute directly for liquid petroleum fuels, they can absorb some of the Nation's oil demand and ease the pressure on world oil prices.

At this time, the most promising world-wide unconventional energy sources appear to be the heavy oils, tar sands, and to a lesser extent, shale oil. The next most economically attractive category of new technologies would be unconventional gas supplies and gas produced from coal. While most unconventional gas supplies have potentially enormous resource bases, production costs are extremely uncertain.

Synthetic liquids from coal seem less immediately attractive than unconventional oils or gases. However, if production costs prove to be at the lower end of the estimates and world oil prices rise significantly, synthetic liquids would be extremely valuable oil substitutes in the U.S. with its large coal resources.

Solar technologies, which constitute the final category of backstops, span the range of priorities. Some are competitive today, but others have production costs even greater than coal liquids.

Figure II-4
Production from Backstop Technologies in the Mid-Term
(Medium World Oil Price Case)



U.S. Backstop Technologies Include:
- Shale Oil
- Synthetic Liquids
- Unconventional Gases
- New Solar Technologies

Production of backstop technologies will make only a small contribution in the mid-term.

It is difficult to predict which unconventional technologies will prove more successful. Further production experience could reveal new social, environmental, or logistical problems that would prevent rapid deployment of apparently promising technologies. It could also lead to unanticipated breakthroughs that dramatically enhance the commercial potential of certain new energy sources.

None of these unconventional technologies, however, is likely to be a perfect "backstop" to world oil prices. In theory, the perfect backstop fuel is one that can produce energy quickly and in virtually unlimited quantities at relatively stable prices. There are various resource, engineering, social and environmental constraints on the deployment and production of all these technologies. Even if not perfect "backstops", however, these unconventional supplies can exercise some constraint on world oil prices by reducing U.S. oil imports to the extent indicated in Figure II-4.

TOWARD A MID-TERM STRATEGY

- As its mid-term objectives, the strategy seeks to (1) keep U.S. imports sufficiently low to protect U.S. security and help extend the period before world oil production reaches its capacity, and (2) develop the capability to deploy a series of new transitional energy technologies as world oil prices rise.

The uncertainties in the mid-term give the U.S. a major opportunity to influence the world energy picture. Indeed, it must do so to ensure that its own economic and political security is not endangered. First and most important, the strategy must continue the movement, established in the near-term, toward replacement cost pricing. As prices rise, such policies will encourage conservation and lead U.S. consumers to meet more of their demand from sources other than oil imports.

Second, an effective conservation strategy in the mid-term must, in some cases, rely on regulatory policies and standards that go beyond the effects of replacement cost pricing. Energy efficiency standards for autos and new building and appliance standards will have a major impact during the mid-term, as the existing stocks of energy-consuming structures and equipment are replaced.

Third, the strategy must recognize that coal and nuclear power--especially coal--will emerge as the critical transition fuels in the mid-term. Today, potential investors in coal-fired and nuclear facilities may well hesitate at the host of environmental, safety, logistical, and regulatory problems associated with these fuels. The mid-term strategy must develop a broad consensus on the best approach to these problems and the conditions that should be set on the use of these energy sources. It should be recognized, however, that slippage in production of either of these sources could intensify the pressure on all other energy forms.

Fourth, the nation must anticipate when new technologies will be needed and how they should be "phased-in" commercially. For those technologies that are nearly competitive, a premium or incentive may be appropriate to encourage production and reduce U.S. imports. For those technologies with greater costs and uncertainties, government can demonstrate their capability for production now and remove uncertainties about costs. By doing so, the government can establish a climate in which these technologies can be deployed rapidly by the private market--if, and only if, they become competitive at a higher world oil price.

Because of the uncertainties in the mid-term outlook, the U.S. cannot afford to pursue any one set of actions too quickly. It cannot rely blindly on the premise that there will be no slippage in projected coal and nuclear-power production, even at much higher world oil prices. It cannot afford to push a particular set of technologies without considering the costs and consequences.

The transition to new unconventional energy technologies and high-cost energy sources will take many years. New technologies will require enormous investments over a long period of time. It would require, for example, about 20 synthetic liquid or gas plants, at a capital cost of $32 billion or more in 1979 dollars, to displace each 1 MMBD of oil imports. It would require 100 such plants, at a capital cost of over $150 billion, to displace 5 MMBD of oil imports.

There should be no illusion that it will be easy or inexpensive to close the Nation's import gap with unconventional technologies. Yet an effort to ensure the timely introduction of these technologies is critical and, apart from the political security benefits, the cost savings could be substantial. Each reduction in U.S. import levels reduces demand for OPEC oil and diminishes the likelihood of further rapid price increases.

To determine the proper pace in developing backstop technologies, it is useful to compare the estimated production costs for these technologies against future world oil price projections. If world oil prices follow the high price path and reach $30 per barrel by 1990, the U.S. is already behind in developing new oil substitutes. If world oil prices follow the low price path, the U.S. has been prematurely investing in such technologies, since commercial production would not likely occur before the next century.

The current strategy, as reflected in the Department of Energy's RD&D budget, emphasizes those technologies which are most likely to be commercially viable if world oil prices follow the medium price path. By the late 1980s, for example, the first commercial plants for synthetic liquids could be on line, since the costs of their products would be close to the prevailing world oil price. No one can be certain how fast or how slowly world oil prices will rise. A prudent energy strategy, however, will plan not only for the optimistic but also for the pessimistic cases, which, even if unlikely, would be extremely damaging to the economy.

C. The Long Term

Government policies, the abundance of various natural resources, the success and cost of new technologies, and the behavior of energy markets and the economy will all influence the form and price of energy after the year 2000. Much of the capital stock that will be in use after the turn of the century has not yet been built or even ordered. Technologies that are now only on the drawing board or in the laboratory may become important. Although profound uncertainty clouds the future, it is clear that by the year 2020, the U.S. will take the vast bulk of its energy from sources other than conventional oil and gas. Even during the 1980s and 1990s, world energy markets probably will begin their long-term shift to higher-cost, unconventional sources, and ultimately in the direction of a "post-petroleum" world.

A wide range of new energy sources and technologies could emerge. And on the demand side, the choices are also diverse. By the year 2020, shifts in lifestyle, population growth, and structural changes in U.S. economic activity could lead to minimal or even no energy growth--or to new, unexpected changes in the patterns of consumption.

The numerous policy and technology options available for the long-term period offer both an opportunity and a quandary. The opportunity lies in the prospect of developing fundamentally new systems for producing and using energy. The quandary lies in the limited ability of the U.S. to pursue the development of all technologies simultaneously. Decisions should be made carefully, in appropriate sequence, with the recognition that more knowledge will permit wiser choices. The current generation cannot and should not impose its own judgments and values on generations yet to come. The final choices about deployment of these technologies must be left to them.

OUTLOOK

The U.S. faces two major transitions in energy markets between now and the middle of the 21st century. The first will occur in the mid-term period when the U.S. moves from an energy system tied to traditional oil and gas sources (including imports) to one relying on unconventional sources. The "transitional" energy supplies include a few cost-effective renewable technologies, but consist mainly of finite, non-renewable energy sources that are not yet in wide use. Examples include enhanced oil recovery, oil shale, coal-derived products, unconventional gas, and conventional nuclear energy. If successfully deployed, these sources will reduce the nation's import dependence without sharp economic disruptions or mismatches between the new energy forms and end-use requirements.

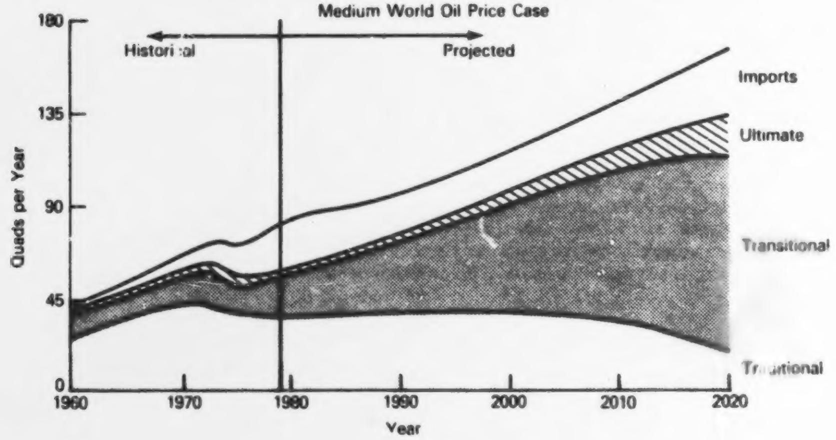
But however large they may seem, even these transitional energy supplies are depletable. For the mid-range projection, recoverable resources of coal and uranium appear sufficient to sustain the expected increases in electricity and other delivered fuels only until the first half of the next century, at the most.

A second transition, therefore, would start after the year 2000. A set of "ultimate" technologies, including all the renewable and advanced nuclear technologies, would begin to displace traditional fuels and non-renewable unconventional supplies. These new sources include the various solar technologies, low-head hydroelectric power, and the advanced nuclear technologies, such as fusion and breeder reactors, which are essentially inexhaustible supplies.

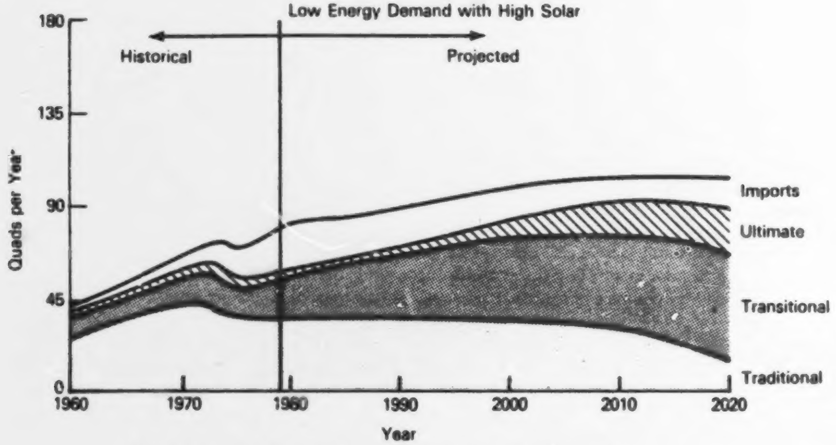
Figure II-5 depicts two ways in which the long-term energy transition might take place. The top figure shows a higher total energy consumption and a conservative estimate for penetration of solar and other ultimate energy sources. The bottom figure shows, for contrast, a lower growth in total energy consumption and an accelerated production of solar and other ultimate energy sources. Which type of transition will actually occur depends largely on uncertain future events such as changes in economic activity and lifestyles (that affect energy consumption) and costs of ultimate energy sources. Both transitions in Figure II-5 show the shifting mix of traditional, transitional, and ultimate energy sources under the medium world oil price case. In both, traditional energy sources (including onshore, offshore, and Alaskan oil and gas) peaked in about 1970. Non-renewable transitional sources are likely to peak sometime around 2020. Ultimate energy sources probably will not dominate the energy picture until around 2070. Regardless of future energy growth and costs of ultimate energy

Figure II-5
Two Possible Long-Term Energy Transitions

Medium World Oil Price Case



Low Energy Demand with High Solar



Traditional sources include: conventional oil and gas, and Alaskan Oil and gas.
Transitional sources include: coal, conventional nuclear, and unconventional oil and gas.
Ultimate sources include: renewables and advanced nuclear (breeder).

sources, Figure II-5 shows that the transition to ultimate sources would be well underway by 2020. Ultimate sources could grow from near negligable amounts in 1975 to about 10 to 20 percent of domestic primary energy consumption by 2000.

Although Figure II-5 represents detailed projections, it is only a rough sketch of the post-2000 world. The uncertainties about resources and prices dwarf any that have been discussed previously. It seems likely, however, that a first group of transitional technologies will slow or stop the oil price increases during the 2000-2020 period. If unconventional supplies are held back by environmental or institutional problems, a new and even larger explosion in world oil prices will occur going well beyond the projections in Chapter I. Indeed, world oil prices would continue to rise until halted by substantial use of renewable and advanced nuclear technologies later in the 21st century.

TOWARD A LONG-TERM STRATEGY

o As its long-term objective, the strategy seeks to bring on renewable and essentially inexhaustible sources of energy to sustain a healthy economy.

For the last quarter-century, the Federal government has been actively supporting development of ultimate energy sources. In the past, however, it has placed disproportionate emphasis on the nuclear production of electricity. A balanced strategy would seek to spur development of a wider range of technology options and ensure a healthy competition among them.

The Department of Energy currently supports development of three major long-term energy sources--including a broad spectrum of solar energy technologies, nuclear fusion, and breeder reactors. It is uncertain which technologies will constitute the base for post-2000 energy supplies. The costs, the environmental impacts, and the technical processes themselves are not well understood in many cases. For that reason, if no other, Federal research and development (R&D) should not focus narrowly on one technology to the exclusion of others.

For solar energy, the strategy would promote with R&D and limited product support those technologies that have significant long-term potential but are still far from economic. With scientific breakthroughs, solar photovotaic cells could competitively feed energy directly to homes and factories. The strategy should also support those renewable technologies such as active space heating and industrial process heat systems, which have significant market potential and in the 1980s and 1990s. Finally, it should continue to study those technologies with highly uncertain potential, such as solar-powered satellites and ocean-thermal conversion plants.

For nuclear fusion, research on the magnetic and inertial confinement concepts will continue with the objective of demonstrating scientific feasibility in the mid-1980s. Decisions will be taken in sequence to select candidate technologies and to initiate construction of large facilities. If all goes well, the U.S. could begin to use fusion energy around the year 2000.

For nuclear breeders, the Department of Energy will defer breeder reactor demonstration pending the outcome of a conceptual design study of a new liquid metal fast breeder reactor and further analysis of the date when breeders might be economic in the U.S. The Department will continue R&D on breeder reactors so commercial development can be initiated if justified by future market conditions and non-proliferation policies.

While advances in energy research can be expected, the U.S. must not assume that somehow technological breakthroughs will solve all future problems. The Nation's scientific community has pioneered incredible advances in the last hundred years. These achievements often produce a degree of technological optimism approaching euphoria.

If major breakthroughs occur unexpectedly, then the Nation's energy future may improve substantially. But the U.S. cannot count on "crash" breakthroughs, Manhattan projects, and other panaceas to solve the world energy problem. A sustainable energy future will not be achieved over-night. And those technical advances that do occur are best encouraged by diligent and aggressive R&D support for a wide range of possiblities.

D. The Strategy in Perspective

Chapter II has proposed the major directions for a national energy strategy spanning several time-frames. This strategy is evolutionary, not revolutionary, in nature. The correct choices on many energy issues cannot be made now or all at one time. Geologic resources, OPEC production policies, potential environmental constraints, technological breakthroughs, and other uncertainties preclude the Nation from adopting any single set of inflexible programs.

The following Chapters summarize current Administration programs, policies, and activities to promote energy conservation and production.

These programs are the bricks and mortar for the larger strategy designs described here. Some of these programs will be phased out and new ones created. The strategy itself, however, will have three enduring characteristics.

First, it must anticipate uncertainties, especially in world oil markets and the Nation's supply sources. Movement toward replacement-cost pricing of oil and gas will prepare American consumers for rising world oil prices in the next decade and beyond. The strategy must also anticipate potential roadblocks to increased domestic production and seek a mix of fuels.

Second, the strategy must reduce uncertainties, as well as anticipate them. By demonstrating the production or conservation capability of unconventional technologies, the Nation can reach better decisions about whether, when, and how those technologies should be deployed. Such efforts can develop "backstops" or deterrents against world oil price increases. It is equally important to solve the environmental and institutional problems that attend the widespread use of coal, nuclear power, and other transitional fuels.

Finally, the strategy must ensure equity--among regions, income classes, and producers and consumers. It must fit into a broader social context that will protect the U.S. standard of living. Energy security is just one more form of the economic security to which every citizen is entitled. The nation's long-term commitment to minimize the political and economic costs of the energy problem must be unswerving. It must not represent, as it has so often in the past, a source of uncertainty itself.

CHAPTER III

CONSERVATION

The first two chapters surveyed the Nation's overall energy position and its oil import problem. Attention now turns to the policies and programs necessary for dealing with the general energy situation. And that requires a focus on specific energy fuels and how they are used. This Chapter centers on conservation--how energy is used by different consumers now and how its use may be reduced in the future. The three Chapters that follow this one focus on the different fuels used to generate that energy.

Energy conservation is best viewed as a series of actions to cut waste and get more from each unit of energy used. This is done in three ways: by improving the energy efficiency of buildings, vehicles, and industrial equipment, by substituting energy-efficient goods and services for energy-intensive ones, and by curbing the need for energy services.

The benefits of conservation are many: it can help to reduce oil imports, it can reduce the environmental, health and safety problems associated with energy use, and it can lower costs to the consumer.

A. Historical Changes in Energy Use

Not only did oil consumption grow rapidly in the three decades following World War II, but so did all energy consumption. Overall energy use jumped 3.5 percent per year between 1950 and the 1973 embargo. Within this rapid overall growth, the individual fuels and end use sectors grew at different rates, as Table III-1 shows. Energy use in the residential and commercial sectors grew more rapidly than the average; so did overall consumption of natural gas and electricity.

These different changes over two decades mirrored significant shifts in the economy. The residential/commercial sector, for example, increased its share of total energy used from 28 percent to 34 percent. Natural gas, the fastest growing conventional fuel, saw its market share swell from 18 percent to 30 percent. Electricity use soared at a rate of 8 percent per year, more than twice the overall average, almost doubling its market share (of primary energy use) from about 15 percent to 26 percent.

These changes in energy use paralleled several trends in the economy as a whole:

TABLE III-1

ANNUAL ENERGY CONSUMPTION GROWTH RATES
(percent per year average)

	1950-1973	1973-1978
Overall	+3.5	+0.9
By Sector		
Residential/Commercial	+4.1	+2.6
Industrial	+3.1	-1.2
Transportation	+3.3	+1.7
By Fuel		
Coal	+0.1	+1.2
Gas	+5.8	-2.5
Oil	+4.2	+1.6
Nuclear power, Hydro power etc.	+4.4	+8.9
Electricity Consumption	+7.7	+3.1

- Population grew over the two decades by 40 percent (1.4 percent per year). But the number of persons in the average household fell as family size decreased and more individuals lived alone. This growth in the number of households accounts, in part, for the faster than average rise in residential energy use.

- Per capita real income nearly doubled during this period growing by an average annual rate of 2.6 percent. Consumers were able to spend more for automobiles and energy-using appliances; they bought bigger houses and more goods generally, which in turn required more energy to operate.

- Energy prices declined by 28 percent in real terms from 1950 to 1970; then they began to rise. This enabled each consumer dollar to purchase more energy at the same time that incomes were rising. It was not so important to most consumers that new cars got fewer miles per gallon, that electric heat used more fuel, or that new products used more energy--both as raw materials and in their manufacture.

- The economy also shifted from producing mainly agricultural and manufactured goods to being more service-oriented. This shift, in part, was behind the faster growth of the commercial sector compared to manufacturing.

During the 1970s, particularly since the 1973-74 embargo, this situation has changed; energy prices have increased and are expected to continue to rise faster than inflation, energy supply problems have emerged, and other independent changes have occurred.

- Population is expected to grow more slowly in the future, perhaps stabilizing early in the next century.

- Per capita income (after removing the effects of inflation) has grown only 1.5 percent per year since the embargo and is expected to slow still more, growing less rapidly in the coming decades than it did in the 1960s.

- The economy will shift toward goods and services that are less energy-intensive.

These changes have important implications for our standard of living in the future. No longer will an imprdved standard of living be closely linked with buying and using more energy consuming goods. Future improvements will depend on using goods and energy more efficiently, rather than simply producing and using more.

This shift has already started. The right-hand column of Table III-1 traces the growth rates in energy use since the embargo. It shows a wide variation: transportation use (over 95 percent supplied by petroleum) has grown at 1.7 percent per year, while industrial energy use has actually fallen by 1.2 percent per year. Even five-year averages can be misleading, since energy use in all sectors dropped 2 to 3 percent between 1973 and 1974 and then started to rise again. (Industrial use continued to drop between 1974 and 1975 because of the recession following the embargo). Some uses of energy have increased considerably since 1974. Energy use in transportation, for instance, grew 3 percent between 1976 and 1978.

Evidence of the shift is seen clearly in the changing ratio of energy consumption per dollar of gross national product (GNP). Figure III-1 shows that this ratio increased significantly before World War I, although part of this increase is due to the displacement of nonindustrial fuels (wood, direct waterpower, etc), which are not included in the energy statistics plotted. The ratio decreased between the World Wars, and has held relatively stable since World War II. A detailed look at the post-World War II period, in Figure III-2, shows that energy use grew only 87 percent as fast as GNP from 1950 to 1966. From 1966 to 1970 it jumped to a rate of 170 percent. But since 1970, energy consumption has grown only 61 percent as fast as GNP, and appears to have dropped even lower during the past three years.

The key question is how this relationship will behave in the future. If the trend of the 1970s continues--toward less energy consumption per unit of economic growth--the Nation will be using about 120 quads of energy by 2000. That is consistent with the base case projection of 120 quads in Chapter II.[1] However, if the 1950-66 downward trend were to govern until 2000, energy use would increase to about 140 quads. The difference is large--more than 20 quads, or 11 million barrels per day in 2000. A jump in the energy/GNP ratio such as the one that occurred between 1966 and 1970, would increase consumption even more.

B. Post Embargo Changes--In Detail

The broad averages detailed above reflect a great many specific changes in energy use in each sector. Some of these specific changes parallel the overall trends and others run counter to them. Figure III-3 shows how fuel was used in 1977 within each sector.

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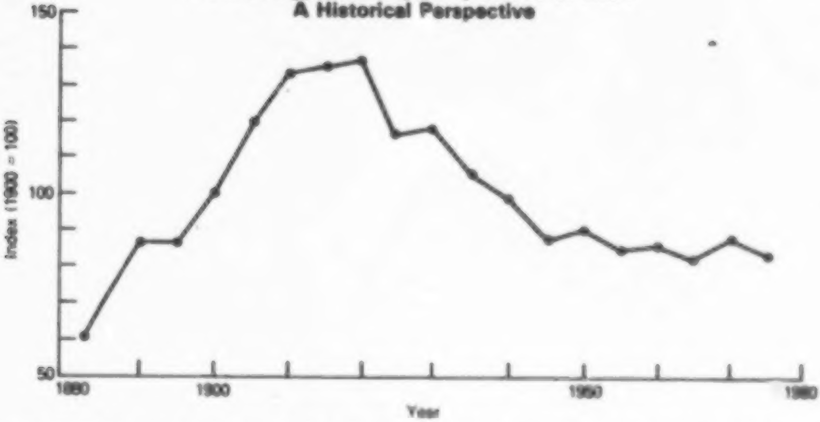
[1] Both based on GNP increases of 3.6% per year until 1985 and then 2.8 percent per year to 2000.

Figure III-1
U.S. Energy Consumption per Unit of GNP:
A Historical Perspective



Source: Sam H. Schurr, "Energy, Economic Growth, and Human Welfare," *EPRI Journal* 3(4): 14-18 (1978). Reprinted with permission.

Figure III-2
U.S. Energy Consumption per Unit of GNP: Post-World War II

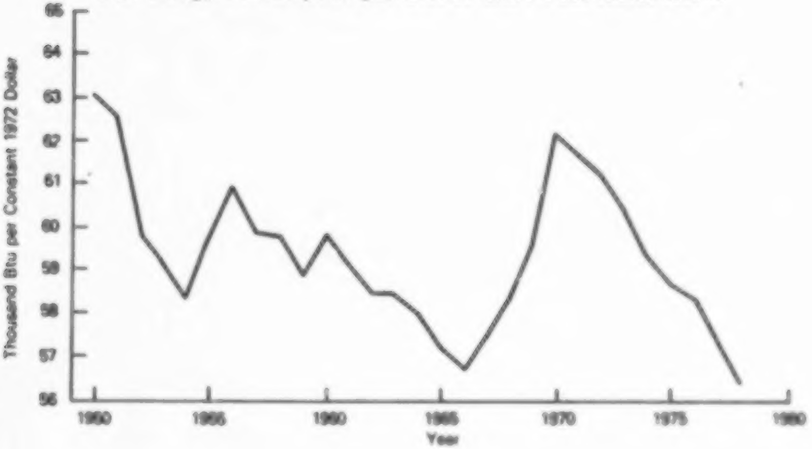
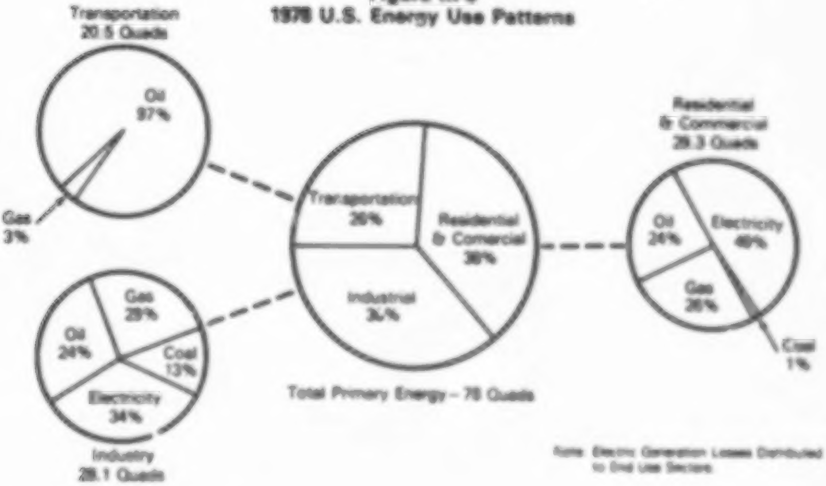


Figure III-3
1978 U.S. Energy Use Patterns



Total Primary Energy – 78 Quads

Note: Electric Generation Losses Distributed to End Use Sectors

HOMES AND BUSINESSES

The residential/commercial sector is highly fragmented, comprising millions of energy consumers, each of whom individually consumes relatively little. The U.S. has more than 75 million residences and over 30 billion square feet of non-residential, non-industrial floor space. An average home uses 130 million Btus per year (for heat, air conditioning, hot water, cooking, drying, lighting and appliances) typically costing the resident from $500 to $1,000 a year. Taken together, all residences use some 10 quads of energy measured at the meter, 14.5 quads when applicable electric generation losses are included. Residences thus account for about 19 percent of all U.S. energy consumed.

Since the embargo, homes and businesses have used energy more efficiently. Fuel price increases, the NEA tax credits, and exceptionally cold winters over large parts of the country, have encouraged homeowners to caulk, lower thermostat settings, add insulation and storm windows, and to conserve in other ways.

New residences built in 1978 will use, on the average, 10 percent less energy than those built in 1973. Appliances that use large amounts of electricity--refrigerators, for instance--have improved an average of 5 percent.

The Federal government owns or leases 2.7 billion square feet of space in more than 403,000 commercial buildings. Since 1975 it has lowered energy consumption in those spaces by 2.1 percent.

TRANSPORTATION

Ownership and energy use in transportation are also highly fragmented. Americans drive more than 100 million automobiles an average 10,000 miles each per year. At the current 14 miles per gallon average for all cars on the road, each automobile consumes about 700 gallons (roughly 100 million Btus) of gasoline each year. Automobiles alone burn about 5.2 million barrels of oil per day, approximately 15 percent of all U.S. energy used or 30 percent of total petroleum consumed. Including the petroleum needed to manufacture cars and build and maintain roads, automobiles use more than 3 of every 10 barrels of oil the U.S. consumes.

Since the embargo, the amount of energy used in transportation has fluctuated. Average automobile travel declined from 10,200 miles per car in 1972 to 9,400 miles in 1975, but then rose to 10,000 miles in 1977. The number of automobiles has been increasing steadily, however, at a rate of about 3 percent annually.

New car efficiency has increased significantly in the wake of the recently implemented mandatory fuel efficiency standards. Based on EPA tests, the estimated mileage of new cars increased 40 percent, from 14 miles per gallon in 1973 to nearly 20 in 1978. (More realistic road tests have since shown a gain to only 16 mpg.) With this improved efficiency, total consumption of motor fuels has risen 2 percent per year since 1973, compared with 5 to 6 percent through the 1960s and early 1970s.

Savings of about 100,000 barrels of oil per day (and several thousand fewer auto deaths each year) have resulted from the 55 miles per hour speed limit. According to the Federal Highway Administration the average speed on rural highways dropped from 65 miles per hour in 1973 to 58 miles per hour in 1974, with the number of drivers exceeding 65 mph declining from 50 percent to 10 percent.

The use of mass transit has increased slightly, after years of steep decline. U.S. mass transit use fell to 6.6 billion trips in 1972, from 23.3 billion in 1945. Since the embargo, however, use of mass transit has increased gradually every year, according to American Public Transit Association data, to an estimated 8 billion or more trips in 1978.

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Airlines, hit hard by the tripling of aviation fuel prices since 1973, have cut fuel use per operating hour by over 3 percent and have raised the average load factor (fraction of all seats occupied) from 52 percent in 1973 to 61 percent in 1978. Recent relaxation of Federal regulations also helped boost the load factor.

INDUSTRY

Unlike the other sectors, industry is using less energy now than it was in 1973, as Table III-1 shows. This reduction comes, primarily, from improved efficiency. Lower output during the 1974-75 recession and the shift in industrial output away from energy-intensive products also played a part. The major energy-intensive manufacturing categories (paper and allied products, chemicals and allied products, petroleum and coal products, stone and clay products and primary metals) account for two-thirds of all manufacturing energy used. Overall their share of industrial output has declined.

Industry has been improving its average energy efficiency, in terms of energy purchased per dollar of value-added, for years. From 1967 to 1974, manufacturing firms lowered their energy use per unit output by an average of 1.2 percent per year. This reduction was accomplished by conservation, recycling, and burning waste products.

From 1974 to 1976 the energy-intensive industries generally improved more than the others. Petroleum refineries improved most, trimming their total purchased energy requirements by over 10 percent per year from 1974 to 1976. Some high energy users did less well; in fact, several--paper mills, industrial chemicals, cement, and steel--used more energy per unit of output. But paper and chemicals shifted to electricity in the process.

Accompanying this overall drop in industrial energy use was a significant shift away from natural gas, partly because of shortages and curtailments. Unfortunately, while industrial gas and total energy use declined between 1973 and 1977 by the equivalent of nearly 1 milion barrels of oil per day, coal use also declined--by 400,000 barrels of oil equivalent per day. Oil use was up by 250,000 barrels per day. Use of electricity also increased, by 150,000 barrels of oil equivalent per day.

Where improvements have occurred, they have been realized by more careful and energy-conscious management of existing facilities, and by improving the processes and technologies that transform raw materials into finished goods. A prime focus of conservation policy is to assure continuing improvement.

C. Conservation Policies and Programs

OVERALL STRATEGY

Because conservation is usually the cheapest and quickest source of new "supplies" it has become a cornerstone of U.S. energy policy. It is important, but not enough, simply to reduce the number of barrels of oil or millions of BTU's consumed; it is also important to make the energy actually used more productive.

The Administration's strategy is to stimulate consumers to use energy in the most cost-effective ways possible, taking into account resource, social, and environmental costs. The strategy also encourages fuel switching away from oil to more abudant sources. Implementing the strategy requires the following steps:

- Correcting price signals to energy users by moving toward replacement-cost pricing of fuels and granting tax credits and other incentives for installing energy-conserving equipment.
- Issuing regulations to reduce or limit energy use in new buildings, vehicles, and appliances.
- Supporting research, development, and demonstration of new technologies that will use energy more efficiently.
- Providing grants for energy-conserving improvements to low-income families, schools, hospitals, and other organizations, not now benefitting from tax credits or other incentives.
- Supplying information on conservation and technologies, including comparative costs and results, so prospective users can make better choices (for instance, life cycle costing and mandatory labeling).
- Overcoming institutional barriers to conservation--for example, by reform of utility rates.

THE MAIN TARGETS

Government actions must address the specific problems and characteristics of the market and be sensitive to the time period in which effects are expected. End-use markets are the chief targets of the Department of Energy's current conservation policies and programs.

The policy that undergirds all others is the movement toward replacement cost pricing for energy. Properly applied, it will stimulate new supplies; it will also encourage conservation in all uses. Phasing out price controls on domestically produced crude oil and implementing the Natural Gas Policy Act are thus as important to the Department's conservation strategy as they are to its supply strategies. Utility rate reform will gradually reduce the need for added electric generating capacity by restraining the growth in electricity demand.

New Buildings

The ideal time to improve the energy efficiency of a building is during design and construction. The building's orientation on its site, basic design, construction details, and insulation can be changed then at little or no added cost. Where appropriate, passive solar designs can be incorporated. If best current practices were used, the average new building could be heated and cooled with up to 50 percent less energy than existing buildings. Use of emerging technologies could boost that figure to as high as 60 to 70 percent.

Because most buyers lack direct control over what is built, the current Federal program to ensure more efficient new construction focuses on new construction standards. The Building Energy Performance Standards (BEPS), mandated by Title III of PL 94-385, are the primary regulatory tool. The standards, which are scheduled to be issued in final form next February, will require that new buildings meet specific energy performance goals such as the maximum number of BTU's per square foot per year. This will retain flexibility for designers and builders to choose the most appropriate means for achieving significant energy savings.

The highly fragmented nature of the building industry, with many suppliers and even more individual builders operating in local markets, makes innovation difficult. The potential benefits of energy-conserving innovations, however, are large when they can be incorporated into buildings with life-times of 30 to 50 years. The Department of Energy is therefore funding RD&D aimed at new technologies for the mid- and long-terms.

Existing Buildings

The long life of individual buildings and the attendant slow turnover rate of 2 to 3 percent per year make it impractical to focus only on new buildings. While it usually costs more to reduce the energy used in existing buildings, the total near-term savings can be very large if many owners upgrade existing buildings. Therefore, the 1978 Conservation Policy and Energy Tax Acts and other legislation provide a number of incentives to stimulate conservation retrofits. They include:

- Residential conservation tax credits in the Energy Tax Act. Up to $300 (15 percent of the first $2,000 spent on insulation, storm windows, caulking, etc.) is allowed for residences.

- Conservation grants for schools and hospitals to make energy conserving improvements. (These nonprofit institutions are not covered by tax credits, so they traditionally are aided by grants.)

- Weatherization grants for low-income families, to help them cope with rising energy prices. Investment in energy-saving measures is the best way to deal with the problem, but low-income families are usually unable to make such investments without help.

- Detailed information on conservation opportunities and programs for homeowners and renters--from the Residential Energy Conservation Service. Under the Conservation Policy Act, utilities are required to help consumers reduce fuel bills by making their homes more efficient. Many utilities have already taken a leadership role in providing such services to their customers. The President has requested that all utilities and heating oil dealers offer conservation services to their customers on a voluntary basis as soon as possible, instead of waiting until the mandatory requirements go into effect in 1980.

All of these programs aim to retrofit existing buildings quickly, to reduce energy consumption and energy bills. As Table III-2 indicates, the Federal outlays and tax expenditures are large. The extent to which they are required to motivate owners to make the necessary investments will be reevaluated before committing to future program extensions and funding levels.

Appliances

Refrigerators, water heaters, stoves, furnaces, air conditioners, and other appliances have shorter lives than the buildings they serve, and replacements are purchased separately. The Federal effort has focused on developing and implementing appliance efficiency standards. Efficiency targets, first mandated in the EPCA and changed to standards in the NEA, now cover 13 categories of appliances. Nine of the standards will be issued by the end of 1980.

Once in effect, and as the appliance stock turns over, these standards are expected to save at least 5 percent of the energy used in U.S. homes.

Automobiles

Since the replacement cycle for automobiles is also relatively short--on the order of 10 years--the primary focus is on new cars. The

TABLE III-2

FUNDING FOR BUILDING RETROFITS
(Million Dollars)

	FY 1979		FY 1980	
	Budget Authority/ Obligations	Tax Credits	Obligations	Tax Credits
Grants				
Schools and Hospitals	$20		$280	
Other Local Government	8		30	
Weatherization	199		199	
Residential Tax Credit		$ 716		$ 434
Total	227	716	529	434

Federal government's main approach has been mandatory fuel economy standards, set in the Energy Conservation and Policy Act (PL 94-163). These standards were implemented beginning with the 1978 model year by the Department of Transportation, using EPA testing procedures. Each manufacturer is required to meet minimum corporate average fuel economy standards for its new car fleet each year. This minimum will rise annually until it reaches 27.5 miles per gallon in the 1985 model year.

A considerable amount of research and development on near-term technologies is being performed both by the auto industry and by the Department of Transportation. These efforts are focused primarily on improvements that will help achieve the 27.5 mpg standard by 1985: use of lighter materials, reducing aerodynamic drag, and improving the efficiency of drivetrains and engines. The Department of Transportation spends about $8 million per year for technology and economic assessment in these areas.

It is not now clear if improvements in existing internal combustion engines will be sufficient to meet tighter standards which might be imposed after 1985, or if new engines would have to be introduced. Industry is improving the gasoline engine and moving ahead with the diesel engine. The Department of Energy and the EPA are studying critical environmental questions, especially those involving diesel exhausts. Such questions must be resolved before diesel engines can be considered for truly widespread automotive use.

The Department of Energy is also supporting longer-term R&D on alternatives to the gasoline and diesel engines. Gas turbine and Stirling cycle engines offer promise of lower pollution and fuel versatility and greater efficiency. Electric and hybrid vehicles would also reduce gasoline use. Existing battery technology is adequate for limited duty vehicles, but improved batteries will be necessary for electric vehicles if their performance is to approach that of conventional automobiles. DOE funding for these two automotive programs totals $85 million in FY 1979 and $84 million in FY 1980.

The Department of Transportation has initiated discussions with the auto industry and a number of research institutions, regarding the possibility of developing an advanced 40-50 mpg automobile for the 1990s.

These RD&D programs are intended to push new technology faster than the major automobile manufacturers would on their own. A substantial, rapid change in vehicle or engine technology would render obsolete large stocks of machinery and trained manpower. This would call for major investments by the automotive service industries--parts and repair--and by the major manufacturers. Unless the problems of financially weaker companies were dealt with, accelerated change potentially could force them out of business and alter the structure of the automobile industry.

Although efforts on automobiles have focused primarily on new car efficiency, savings can also be achieved with more efficient use of existing automobiles. Commuting to and from work is a primary target since it involves approximately one-third of automobile use. Carpooling or mass transit frequently provide an alternative, and a number of Federal efforts are aimed at stimulating ridesharing and other actions to use existing transportation systems more efficiently. Free or otherwise subsidized parking at the work place gives the wrong economic signal, encouraging commuters to use their cars. To correct this situation the President has directed that subsidized parking for Federal employees be phased out. He also called upon State and local governments and private employers to follow suit by eliminating subsidized parking, so as to encourage carpooling, van pooling and use of mass transit.

Mass Transit

Although transportation accounts for over half of the total petroleum consumption of the United States, the most energy-efficient form of transportation--mass transit--accounts for only 5 percent to 6 percent of urban passenger travel. If mass transit ridership increases, and attracts riders away from low occupancy autos, it can be a major element in the Nation's conservation strategy.

To increase ridership, transit capacity must be increased in the short term at a rate faster than currently planned. That increased capacity must be available at the times of the day when it can make a difference -- during peak commuting hours. Many mass transit systems are now filled to capacity during rush hours. Federal grants already have made possible significant improvements in mass transit systems, and cities such as Seattle, Denver, and Atlanta, among others, have put clean, reliable, and innovative transit service on the streets.

If the Windfall Profit Tax is enacted by the Congress and the Energy Security Fund established, the President will propose that funding be increased for those transit projects that can begin to yield tangible benefits soon. Over the next 10 years, a total of $3.1 billion from the Fund would be targeted toward this objective--over and above the amount now planned to be spent. These increased funds will make it possible to purchase 1100 to 1500 more transit buses a year than the 3000 to 3500 now provided for. Funds also would be applied to expand the level of rehabilitation work on existing subway and commuter rail systems, to assure they will be available and reliable when called upon to carry more people.

This additional activity will be funded through the bus and rail rehabilitation grant programs authorized by the Surface Transportation Assistance of 1978.

Truck, Air, Rail and Marine Transport

Other transportation modes are equally dependent on petroleum and together account for about 3.5 million barrels per day or about 20 percent of petroleum consumption. Of this amount nearly 60 percent is consumed by trucks and about 25 percent by aircraft, the remainder being split about equally between rail and marine freight transport.

Trucks, because of their substantial fuel use, are a major focus of government conservation efforts. About half of truck fuel is consumed by light trucks and vans, currently the fastest growing segment of the automotive industry. Because of the extremely wide diversity of vehicle uses, the only effective conservation tool is the application of mileage standards similar to those for automobiles. Standards for model years through 1981 have been set, and standards for future mileage improvements are being developed.

For heavy trucks, simple technical "fixes," such as the drag shield on the roof of truck cabs; changes in regulations that will allow higher load factors; and major technical innovations such as bottoming cycles are being pursued. Bottoming cycles are supplemental engines that generate additional power from the exhaust of diesel or turbine engines used in transportation and stationary applications.

Civilian aircraft energy use--almost exclusively for commercial passenger transport--has been under continuing surveillance by the National Aeronautics and Space Administration (NASA) for many years. New generation aircraft now in service are as much as 30 percent more efficient than the original jet fleet which is now being retired. Results from NASA's R&D programs are expected to be available by the mid 1980s, when significant further replacement of the aircraft fleet is expected to start. The R&D program goals call for enhancing aircraft fuel efficiency as much as 30 percent more through improved wings and more efficient engines. NASA's program on improved aircraft efficiency is funded at more than $100 million per year.

Railroad consumption of about 300,000 bbl/per day is almost exclusively related to freight movement. DOT's Federal Railroad Administration is developing improved equipment and operating techniques at its 50 square mile Transportation Test Center in Colorado. Federal funding for rail R&D is about $50 million per year.

About half of the 250,000 barrels of oil per day consumed by marine transport is used in the inland waterways where highly efficient diesel tugs provide the power. The other half is in coastal traffic where the trend toward greater use of diesels should improve efficiency significantly. Economics should spur this trend so no substantial government incentives are required.

Industry

As noted earlier in this Chapter, industry uses more energy than any other sector, and is therefore critically important to the nation's overall energy conservation efforts. The diversity of applications, technologies, plants, and equipment in the industrial sector make it particularly difficult to design and implement detailed regulations, such as auto mileage standards and building standards. The government's basic strategy therefore embraces more general activities: energy pricing policies to correct pricing signals, investment tax credits for energy-conserving investments, energy information reporting programs, improvement targets, and jointly funded RD&D.

- Changes in energy pricing policy are particularly appropriate to stimulate industrial conservation. The greatest leverage exists when new plants are built.

- The National Energy Act provides an additional 10 percent investment tax credit (increasing the total credit to 20 percent) for retrofitting certain energy conservation equipment. The tax credit, which applies for the next 4 years, will speed the introduction of improved equipment and technologies by making it financially attractive to act sooner rather than later.

- The Industrial Reporting Program mandated by the Energy Policy and Conservation Act (EPCA) and the Voluntary Industrial Energy Efficiency Target Program generate information on progress in industrial conservation using current technologies.

- The Department is funding, jointly with industry, a number of energy RD&D conservation programs. These efforts are intended to speed the development of technologies widely applicable to many industries or applicable to particular energy-intensive industries. A variety of technologies--such as high efficiency electric motors, advanced combustion controls for industrial boilers, and advanced cogeneration concepts such as bottoming cycles--are being developed. So are a number of other projects applicable to specific industries. One new system will save 80 percent of the natural gas now used in a paint-curing operation; a new crude oil distillation process will save 40 percent.

Funding for the Department's industrial conservation program is $40 million in 1979 and $42 million in FY 1980. The tax credit is expected to average about $200 million per year.

The Federal Government

The Federal Energy Management and Planning (FEMP) program, authorized by the Energy Policy and Conservation Act (EPCA), aims to reduce the energy use in existing Federal buildings in 1985 by 20 percent, and in new buildings by 45 percent.

All new Federal buildings will conform with the Building Energy Performance Standards. DOE is also establishing life cycle costing procedures to evaluate retrofit projects for existing Federal buildings. Audits will be completed for most Federal buildings.

Presidential Executive Order 12003 set a goal that, beginning in 1980, the Federal automobile fleet's average fuel economy should exceed the EPCA-mandated standards by 4 miles per gallon.

DOE and other affected Federal agencies will prepare a 10 year plan for energy conservation in Federal buildings, covering lighting, thermal and insulation requirements, hours of operation, thermostat controls, and building retrofit plans. Like the private sector, the Federal government must improve its energy conservation performance.

D. The Role of Conservation

Because energy supplies will always be limited and increasingly expensive, conservation is critical to the nation's future. Continuing the 1970s trend of about 0.6 percent growth in energy consumption for each 1 percent of economic growth, rather than resuming the 1950-1966 ratio, will reduce our year-2000 energy needs by the equivalent of 11 million barrels of oil per day.

The Administration's energy conservation policies and programs are designed to assure that this trend not only continues, but quickens. Moving toward replacement-cost pricing for oil and natural gas will send consumers the correct economic signals and make conservation investments more attractive. Temporary tax credits will speed the process, especially since it may take several years for energy prices to reach replacement cost levels. Standards and regulations are needed in cases where consumers do not control key design decisions or are relatively indifferent to investing more initially to cut energy costs over time.

The President has directed that a special task force of the Energy Coordinating Committee be formed to develop further recommendations to improve national energy productivity. This task force will identify additional long-term measures to increase the energy productivity of all segments of the economy. It will have two principal responsibilities. First, it will review the existing conservation programs of the Federal government and make recommendations to the President on how they might be improved. Second, it will work with all Federal agencies to review their regulations and programs to ensure they do not discourage energy efficiency and productivity.

Carrying out existing Federal laws and new ones as they are enacted requires a continuing dialogue with State government. DOE has already held a number of conferences and workshops around the Nation to discuss sections of the National Energy Act with officials from State energy and State regulatory agencies. The President has directed DOE to host a series of national workshops with State public utility commissioners and other staffs to explore key conservation issues.

As discussed in Chapter VII, the President will submit the Energy Management Partnership Act to Congress. This would assist States in establishing a means for integrating energy management and monitoring energy programs at the State level.

Achieving goals of continued economic growth with lower energy growth requires more than government actions and programs--it requires the wholehearted cooperation of individual citizens and business. The benefits of conserving energy are great and the consequences of not doing so are frightening. The Federal government will provide the appropriate incentive but every person must respond for conservation efforts to succeed.

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CHAPTER IV

OIL AND GAS

Petroleum and natural gas contribute nearly three-fourths of all the energy used in the United States--and a comparable percentage worldwide. These fuels are portable, clean, and easy to use, making them the fuels of choice in nearly every sector except electric utilities.

In the future, as Chapter II pointed out, the U.S. will probably meet its growth in energy demand from sources other than oil and gas. And in the electricity sector, oil and gas use should be negligible by 2000. But high levels of oil and gas production will be needed well through the early decades of the 21st century, particularly for transportation, high-priority industrial activities, and residential and commercial facilities. To maintain these high levels presents one of the major challenges of energy policy, since production in the lower 48 States will decline steadily.

The Administration's strategy for oil and gas has four basic principles:

First, the U.S. must price its traditionally cheap domestic oil and gas supplies at their true replacement cost, and reserve them for those sectors that have no ready alternatives to these fuels.

Second, the U.S. must provide adequate producer incentives to increase conventional production, as well as remove barriers and supply bottlenecks that prevent accelerated production.

Third, the U.S. must conduct R&D and design incentives that stimulate use of unconventional liquids and gases that can be competitive or nearly so with conventional oil and gas.

Fourth, the U.S. must develop the capability for production of liquid fuels and gases manufactured from coal or other abundant resources. Though these technologies are not economic at current world oil prices, the U.S. should determine the conditions under which they would be economic, reduce their technical and economic uncertainties, and have the ability to deploy them rapidly if world oil prices reach that level.

The oil and gas strategy outlined here requires careful judgment in its implementation. No one can predict precisely the rate at which world oil prices will rise, or the pace at which expensive new technologies should be developed. Nor can policies be based on a too-easy distinction between "conventional" and "unconventional" supplies (or among unconventional supplies). Liquid fuels and gases form a single continuum, especially with respect to production costs and market potential.

If it were certain that oil prices would rise rapidly, then it makes economic sense to expedite the development of even high-cost technologies with the processes now available--especially those that can deliver massive energy supplies. Or, if it were certain that oil prices would remain low, it makes sense simply to continue R&D programs that aim at reducing the cost of these technologies.

Since certainty is impossible, the Administration has sought a middle approach. Government will work with industry to demonstrate the production capability of several new technologies in commercial scale modules as soon as possible. Such efforts would not seek to build massive production capacity for these technologies, however, until future oil price behavior becomes clearer.

This middle approach would avoid enormous subsidies to uneconomic technologies. But it would develop the information and technical expertise needed to deploy new technologies rapidly and displace large quantities of imported oil at the higher prices.

In general, conventional and unconventional liquid fuels and gases should be developed in an order of priority that reflects expected production costs. The NEA and the Second National Energy Plan set the highest priority on development of new conventional sources, including Alaskan oil and gas, as well as enhanced oil recovery. Next in priority are oil and gas supplies in unconventional hydrocarbon formations--such as heavy oils, tar sands and oil shale. Finally there are the synthetic fuels manufactured from coal.

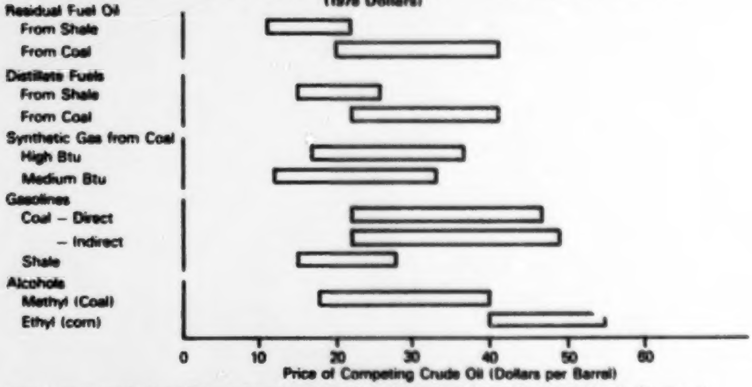
In the past, the Federal government has used pricing and regulatory policies for fuels that are already economic. It has relied on R&D programs to develop and mature expensive, uneconomic forms of energy production. Certain unconventional oil and gas fuels, however, may become economic in the near future, and the commercial production of these fuels can be stimulated with application of both pricing and regulatory incentives as well as conditioned R&D.

Figure IV-1 gives some indication of the comparative economics of new production technologies. Liquid fuels produced from shale oil and methanol and synthetic gas from coal come closest to being competitive at today's world oil prices, if their costs are at the low end of the ranges in Figure IV-1. Liquid fuels from heavy oils and tar sands, however, are even cheaper than any of these sources; the total costs of their production vary from $10 to $20 per barrel for heavy oils and from $7 to $16 per barrel for tar sands.

Figure IV-1

1990 Crude Oil Prices Required To Make Synthetic Fuels Competitive

(1978 Dollars)



Notes: 1. Using gasoline from shale as an example, the cost of gasoline produced from shale is expected to be the same as that of gasoline produced from conventional crude oil in a typical U.S. refinery when the crude oil costs between $15 and $20 per barrel.

2. The low end of the range reflects an optimistic interpretation of available data and financing terms commensurate with a mature plant; conversely, the high end reflects a conservative interpretation and a pioneer plant.

3. Financial assumptions include an inflation rate of 6%, income tax rate of 50%, investment tax credit of 10%, project life of 20 years, 16-year double declining depreciation, and a real interest rate of 3%. Reflecting Note 2, debt/equity ratios of 30/70% and 0/100% and real return rates of 8.5% and 15% are used.

In the mid-term and beyond, the heavy oils, tar sands and shale oil are likely to be far more viable commercially than the coal-synthetic fuels. Unfortunately, the most economic unconventional sources are either found mainly outside the U.S. (e.g., the heavy oils, tar sands), or they are subject to special environmental limitations (e.g., oil shale). Hence, development of the less economic coal-synthetic fuels must also be a critical part of the oil and gas strategy.

The final product costs of the fuel technologies shown in Figure IV-1 could vary as much as 100 percent, due to project financing and other uncertainties. The fuel markets in which these technologies compete will also help determine when they become economic. Some of the technologies produce only lesser-valued boiler fuels, such as residual fuel oil; others produce higher-valued transportation fuels, such as gasoline.

Past experience indicates that the product costs of these new technologies, which are likely to be the critical oil substitutes, could be near the high end of the ranges in Figure IV-1. A prudent energy strategy must anticipate this category of product-cost uncertainties, as well as uncertainties in world oil prices.

A. Oil

U.S. oil supplies have increased throughout the century in sharp, uneven bursts (as shown in Figure IV-2), which indicate the discovery of supergiant fields and new oil provinces. But new discoveries and extensions of known fields have not kept pace in recent decades with the virtually exponential demand growth of an oil-based U.S. economy. As Figure IV-3 indicates, domestic production of crude oil began to surpass the yearly additions to crude oil reserves in the 1960s. Today, the ratio of reserves to production in the lower-48 States has fallen to 7.5 to 1. This ratio, indicating the speed at which known reserves are produced, is one of the lowest in the world.

U.S. policies toward oil have changed with its oil supply situation. In the 1950s, the Nation adopted "voluntary" import quotas to protect American producers from competition with then-cheap Middle East oil. The quotas became mandatory in 1959, but imports rose through the 1960s, as new quota exceptions were added. When the U.S. oil industry could no longer keep up with domestic demand, the quotas were abandoned in 1973, and replaced by a system of license fees to encourage domestic production and refining.

As Table IV-1 shows, the U.S. has needed ever larger infusions of imported oil throughout the 1970s. Between 1970 and 1978, oil imports rose from 23 to 42 percent of domestic consumption.

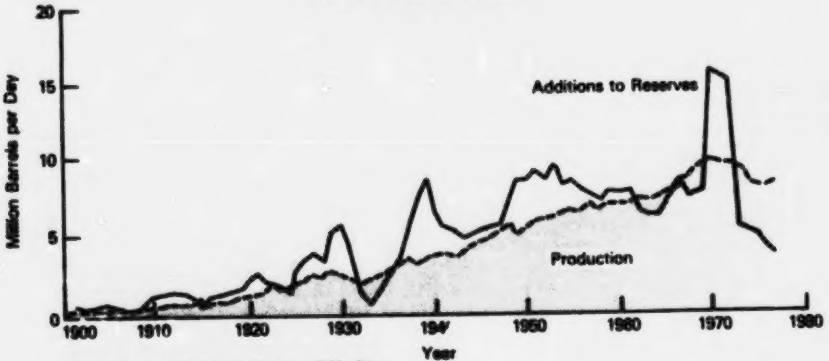
TABLE IV-1

U.S. PETROLEUM IMPORTS

	Million Barrels Per Day	Percent of Consumption (Btu basis)
1960	1.8	20
1970	3.4	25
1975	6.1	40
1977	8.8	50
1978	8.2	46

When world oil prices quadrupled in 1973, Congress imposed price controls on domestic oil. The relative economics of domestic and foreign oil abruptly changed--to the unintended detriment of the Nation's energy security. Domestic oil became a bargain, even as U.S. production was

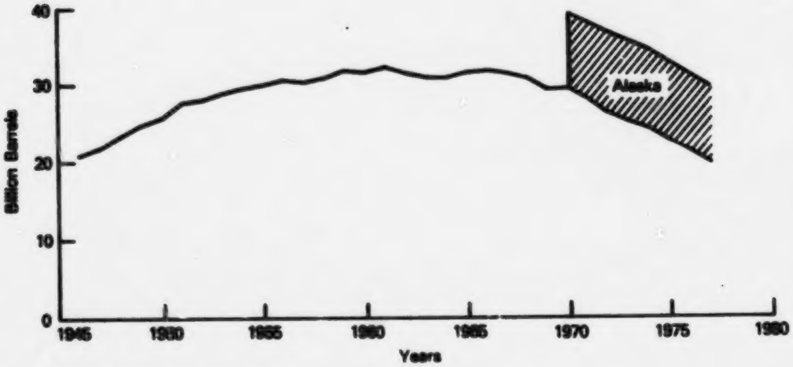
Figure IV-2
Additions to Crude Oil Reserves[1] and Production of Oil



Beginning and cutoff determined by available data.

[1] Three-year moving average.

Figure IV-3
U.S. Oil Reserves



Source: American Petroleum Institute.

declining and import dependence was mounting. Meanwhile, to prevent regional inequities--New England relied on imported oil, and producing regions had access to domestic oil--the Federal government created a system of entitlement payments among U.S. refiners that equalized the costs of acquiring oil. This cumbersome, ad hoc system of price controls and entitlements has remained in place until now, and subsidized U.S. oil consumption at a time of rising world oil prices.

In 1970, production of domestic crude oil and condensates peaked at just under 10 MMBD, and has declined steadily ever since. New Alaskan production offset this decline temporarily in 1977 when the TAPS pipeline opened. In the lower-48 States, most new additions to reserves have come in the recent past from extensions and revisions of known fields. In the future, additions to reserves will have to come from discoveries of new fields, as today's oil fields become even older. Enhanced recovery will be especially critical to the U.S. in maintaining current levels of production.

Meanwhile, to a disturbing degree, recent U.S. exploration--in the Atlantic Outer Continental Shelf, the Gulf of Mexico and other offshore regions--has produced many dry holes. New discoveries may be smaller on average, and perhaps more concentrated in remote areas like Alaska.

As Table IV-2 shows, lower-48 onshore regions even now account for little more than half the Nation's proved crude oil reserves. Proved Alaskan crude oil reserves already equal 9.6 billion barrels. Discoveries outside the Prudhoe Bay field--possibly in the Beaufort Sea and elsewhere--could increase Alaska's reserves sharply.

To date, however, Alaskan production has not contributed as much as expected, since markets for the oil on the West Coast are limited. A sustained high level of U.S. oil supplies will require greater production from Alaska, discoveries of new fields in onshore and offshore regions in the lower-48 and Alaska, greater production of price-controlled lower-tier oil (which is declining at an accelerating rate), and enhanced oil recovery from existing fields.

Finally, over the next few years, the U.S. may experience shortages of certain refined petroleum products. Table IV-3 indicates that over the near term, consumer demand for gasoline, distillate oils and other "light" products will remain high. However, as the heavy crude oils from Alaska and California account for a greater percentage of U.S. supply, the mix of domestic oil will become heavier in gravity. The gravity of an average barrel of U.S. oil will drop from 30.4° in 1977 to 29° in 1984--a significant decrease in oil quality. To use this oil

TABLE IV-2

POTENTIAL U.S. CRUDE OIL RESERVES AND RESOURCES[1/]

(Billion Barrels)

	Remaining Potential			
Region	January 1, 1978 Proved Reserves	Indicated and Inferred Reserves	Undiscovered Recoverable Resources	Total
Lower 48:				
Onshore	17.4	18.5	40.7	59.2
Offshore	2.5	2.7	17.7	20.4
Subtotal	19.9	21.2	58.4	79.6
Alaska	9.6	6.4	27.0	33.4
Total	29.5	27.6	85.4	113.0

and still meet product demand, U.S. refiners will have to make large investments to improve or upgrade their capacity to process a greater amount of lighter refined products from heavier oils.

Current controls on crude and product prices have inhibited these investments to date. Refinery "retrofits" should become more economic in the future, however, as the lighter crude oils on which U.S. refiners have relied become scarcer and more expensive. Refining costs for gasoline and other light products could increase by as much as $.03 per gallon. As the Nation seeks to develop more oil and new oil substitutes, it should pay careful attention to actual market needs and product demands of U.S. consumers.

STRATEGY FOR LIQUID FUELS

Liquid fuels now provide half of the Nation's fuel and will continue to supply a large, though decreasing, part of energy needs throughout

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[1/] Excludes natural gas liquids.

TABLE IV-3

DEMAND FOR REFINED PETROLEUM PRODUCTS

	Percent of Total Product Demand[1/]	
	1978	1985
Gasoline	39	36
Jet Fuel	6	6
Distillates	19	20
Residual	16	17
Other[2/]	20	21
	100	100

the near, mid, and long-terms. The strategy is to guarantee adequate supplies of these liquids. The U.S. would--

- o encourage maximum exploration and production of domestic oil resources by greater price incentives for conventional oil production;
- o reduce demand growth for petroleum through replacement cost pricing;
- o remove bottlenecks and barriers to accelerated production from the Alaskan North Slope, Outer Continental Shelf, and elsewhere;
- o seek to multiply and diversify the foreign sources of U.S. oil supply to reduce the risks of embargoes and disruptions and to reduce pressures on price in the world oil markets;

[1/] 1985 is from medium price case projections. Totals may not add due to rounding.

[2/] Includes liquified gases, petrochemical feedstocks, asphalt, still gas and other miscellaneous products.

- encourage enhanced oil recovery through new regulatory incentives and expanded research and development;
- provide incentives for commercial production of shale oil, heavy crudes, tar sands and gasohol; and
- demonstrate the capability for production of synthetic liquids and gases that have potential to substitute for oil in large quantities at higher prices.

Incentive Oil Pricing With Tax

Central to the liquid-fuels strategy is resolution of the main unfinished business from last year's National Energy Act, oil pricing. The President's proposed solution--phased decontrol with a windfall profits tax--is designed to strike a balance between immediate U.S. concerns over inflation and the long-run inflationary and other risks of high imports. The windfall profits tax offers the U.S. the opportunity to recognize the prevailing world price as the real cost to the economy for additional energy use, while ensuring that any windfall to the producers is put to work for the citizens of the country. Receipts from the windfall profits tax would be used to establish an Energy Security Fund. This Fund would minimize the impact of higher energy prices on low income households, improve mass transit systems, and provide incentives for commercialization of shale oil, solar and other technologies.

Under the Congressional mandate of the Energy Policy and Conservation Act of 1975 (EPCA), price controls expire in October of 1981. The President has discretion to modify or eliminate these controls as of June 1, 1979. Since an extension of price controls could only compound the economic dislocations caused by the control system and contribute an increase in oil imports, the President has decided to decontrol domestic oil prices by September 30, 1981. However, to minimize the sudden inflationary impact that could result at the time of decontrol, the President has adopted a more gradual path of phased decontrol.

The Department of Energy will complete or undertake administrative actions, pursuant to applicable rule-making procedures, designed to phase out controls on all domestically-produced crude oil over a 28-month period. By September 30, 1981, all domestic prices should be at the world price level.

Approximately two thirds of all domestic oil is now under price controls. Lower-tier or "old" oil, discovered or produced before 1973, now sells for about $6 a barrel. Upper-tier or "new" oil, discovered and produced since then and not otherwise exempt from controls, sells for about $13 a barrel. Beginning in early 1980, prices will be gradually increased for upper-tier and for such lower-tier oil as does not already qualify for one of the special incentive categories. Under this schedule for upper- and lower-tier oil prices, the windfall profits tax can be in place as these changes become effective.

Completion of the required administrative actions will result in the following decontrol schedule:

- o Newly discovered oil will receive the world market price, beginning on June 1, 1979. Although only a small amount of oil falls into this category at first, it will increase in size as new discoveries are made.
- o As of June 1, 1979, 80 percent of all production from marginal wells will be eligible for the upper-tier price. Marginal wells are those wells which produce below a certain volume of oil per day, depending upon the depth of the well. On January 1, 1980, the remaining 20 percent will be eligible for the upper-tier price.
- o Beginning on January 1, 1980, the upper-tier oil price will increase in equal monthly increments until it reaches the world price on October 1, 1981.
- o As of January 1, 1980, lower tier oil will be permitted to decline at a rate of 3 percent per month. Between June 1, 1979 and January 1, 1980, the decline rate will equal 1-1/2 percent per month, a rate equal to the natural decline rate experienced for lower-tier well in 1978.

In addition, a program will be implemented, as described later in this Chapter, to stimulate enhanced oil recovery.

The President's program would apply to approximately one-third, or about 31 percent, of the Nation's annual consumption of oil. Chapter VIII of this Report describes impacts on economic activity, employment, inflation and balance of trade.

The windfall profits tax would recapture 50 percent of any price increases in released lower- and upper-tier oil. Equally important, it would also capture 50 percent of excess revenues from future real OPEC price increases, even after completion of the decontrol process. The tax would remain in effect on sales of decontrolled upper-tier oil for a full 10-year period.

The windfall profits tax would bring in $766 million in 1980, $2.5 billion in 1981, $2.8 billion in 1982--and even more if world oil prices rise significantly. Between 1979 and 1981, if there are no increases in world oil prices, the windfall profits tax would collect $3.2 billion, and Federal income taxes and royalties would collect another $5.1 billion--a 55 percent total increase in Federal tax receipts from decontrol. Oil company after-tax revenues would rise by $6 billion.

By the end of 1981, the Energy Security Fund would receive a total of $8.4 billion from the new windfall profits tax on wellhead sales and Federal taxes on corporate income.

Removal of Supply Bottlenecks

With the expected long-term decline in conventional lower-48 oil production, the Nation can scarcely afford continued bottlenecks to greater domestic oil production.

Alaskan Oil--Production of Alaskan oil has increased from 0.3 MMBD in 1977 to 1.2 MMBD currently--and may reach as high as 1.5-1.8 MMBD by 1985. However, the North Slope fields are over 2000 miles from the nearest markets on the West Coast, and are even further from major consuming areas in the Eastern U.S.

In 1973, the Trans-Alaskan Pipeline Act placed limits on the export of Alaskan oil to foreign markets, such as Japan. Subsequently, an amendment to the Export Administration Act (P.L. 95-52), passed in 1977, further restricted the President's authority to consider such exports or swaps.

West Coast refiners have been unable to absorb all of the North Slope production. Demand on the West Coast is predominantly for light low sulfur products, to meet strict environmental standards and the heavy demand for gasoline.

Currently, only 700,000 to 800,000 barrels per day of Alaska oil can be used by West Coast refiners. Tankers carry most of the rest--300,000 to 400,000 barrels per day--through the Panama Canal to the Gulf Coast. These shipment costs add another $3.10 per barrel to the already high transportation charge for the Trans-Alaska Pipeline. As transportation charges take a greater portion of the selling price of the oil, the value of the oil received by producers "at the wellhead" must shrink. This reduction in value inhibits North Slope producers from selling more oil on the Gulf Coast and from increasing their production generally. In addition, the existing surplus of this oil on the West Coast is depressing crude prices and discouraging further investments in exploration and production of California's crude oil supplies.

The solutions to this problem require both the building of more efficient transportation systems to move the surplus to refineries where it can be used and the retrofitting of existing refineries on the West Coast to increase their capacity to process heavier crudes into marketable products.

The Administration has sought to expedite the approval and construction of west-to-east pipelines, particularly the SOHIO Pipeline. The construction of the SOHIO pipeline, with a capacity of 500,000 barrels per day, will expand the market for Alaskan and other West Coast oil, reduce significantly the costs of transportation, and thus further stimulate production without additional cost to the consumer.

The pipeline is already laid, and the physical modifications necessary to convert it from gas to crude oil shipment are relatively modest. Yet 5 years have passed since the project began. Indeed, on March 13, 1979, SOHIO announced its intention to terminate plans for construction of the project because of the risk of protracted litigation in California which threatened the economic viability of the project.

The SOHIO project has become a critical test of the Nation's ability to break through the maze of well-intentioned permit requirements that have paralyzed projects essential to the Nation's energy future.

A two-pronged approach has been developed to overcome the impediments to construction. First, SOHIO agreed to resubmit its application to the California South Coast Air Quality Management District (SCAQMD) with a pledge by Federal and State officials that every effort would be made to remove the remaining obstacles within 6 months. Second, the Administration--with the support of the State of California--will work with the Congress to enact Federal legislation which will limit litigation over the permits and ensure that the project moves forward. Such legislation will also guarantee that air quality in California is protected, and that State and local concerns are considered fully in this area.

In addition to the SOHIO project, a process has begun under the National Energy Act to permit the President to choose an additional pipeline or pipelines that can best deliver Alaskan crude oil to inland States and meet the crude oil needs of the "Northern border" and other inland states. The President has asked the Secretary of the Interior to speed the selection process so that the President may make a final decision before the end of the year. Discussions have already been held with Canada to expedite any Canadian government recommendations on proposed pipeline systems.

Finally, while no proposal has been made to export or swap Alaskan oil--and none may ever be--it is important that the President have the flexibility to consider various ways to increase production of Alaskan oil. Swaps or exports could provide new markets for Alaskan oil and Californian oil, stimulate greater production, allow significant transportation savings, strengthen ties with Mexico, and bolster the U.S. balance of payments. Exports might also be one way of fulfilling oil supply agreements with Israel. While many other factors would have to be weighed in determining the advisability and characteristics of any Alaskan oil exports or swap, Presidential authority will allow timely action when and if appropriate.

Leasing Federally Owned Lands--The Outer Continental Shelf (OCS) is the last major frontier for domestic oil and natural gas exploration and production. The U.S. Geological Survey estimates that 32 percent of all undiscovered oil resources and 22 percent of similarily defined natural gas resources may be located on the OCS. Of the 560 million acres in the OCS, only 6 percent has been offered for lease, and only 1.8 percent is currently under lease. Many of the unexplored frontier areas may contain significant oil and gas resources. Federal leasing of these resources presents a unique opportunity to increase domestic energy production.

The Department of the Interior has established an OCS leasing program that began with the passage of the Outer Continental Shelf Lands Act of 1953 (OCS Lands Act). Early leasing activity focussed on the Gulf of Mexico, with considerable success in discovering and producing both oil and gas. Although the Gulf of Mexico is now considered a mature area, it continues to be one of the preferred provinces for future leasing. Efforts to expand leasing to other areas of the OCS have been blocked by legal challenges on environmental grounds.

The 1978 Amendments to the OCS Lands Act provide the framework in which to develop a more desirable leasing program. Among other provisions, this legislation requires the Department of the Interior to submit to Congress a five-year leasing program. This program, now being prepared, will be developed in full consultation with affected coastal States and other Federal agencies. The President has also directed the Secretary of the Interior to increase the total acreage to be included in the new leasing program.

The Naval Petroleum Reserve on the North Slope of Alaska (NPR-A) is another promising source of oil and gas. The difficulties of exploration and development under Arctic conditions make production from NPR-A a longer term prospect. Later this year, the President will propose to Congress exploration and development by private companies under carefully controlled conditions. These recommendations will be based on an evaluation of NPR-A being completed now by the Department of the Interior and will give careful consideration to the environment, the concerns of the State of Alaska, and the native inhabitants of the region.

Management of Oil Imports

Even though imports will provide a declining percentage of total oil use, the Nation will have to accept some level of import dependence as inevitable. Chapter VII describes those measures that can respond to sudden supply interruptions, and even deter them--such as the Strategic Petroleum Reserve and various contingency plans for demand-restraint and rationing. This section, however, examines the ways the U.S. can influence long-run patterns of foreign oil importation.

Diversification of Imports--Because of its large oil resources, the Middle East has been and will remain a critically important source of oil supplies. Recent events in Iran, however, have underscored that this region is a particularly unstable supply source. The U.S. should attach priority to actions that limit future dependence on the politically unstable Middle East by diversifying sources of U.S. oil imports. There is a range of appropriate diplomatic, technical and financial inducements and exchanges with non-OPEC countries which it would be mutually advantageous to pursue.

There are several potentially abundant, relatively secure and accessible sources of foreign oil and gas that have not yet been fully explored or developed. Over the next decade, however, the most promising sources are those which have been relatively well explo .

The Administration is developing an international strategy to encourage greater oil and gas exploration worldwide. Such cooperation will require innovative institutional and commercial arrangements to complement traditional U.S. reliance on the efforts of the major oil companies. At the request of economic summit leaders, including President Carter, the World Bank has been financing hydrocarbon exploration as well as production in developing countries.

Reform of Foreign Tax Credit Treatment to Oil Companies--Multinational oil companies are receiving benefits through foreign tax credits which do not further energy objectives and cost American taxpayers millions of dollars each year. The President proposes to close loopholes in foreign tax credit treatment of these companies in two ways--one requiring legislation and the other by regulation.

The President will propose legislation to limit the credit against U.S. income taxes for oil-and-gas extraction income taxes paid to foreign governments. The credit would be restricted to the income on which those taxes are imposed. Excess credits "earned" on foreign oil-and-gas extraction income would not be able to shelter other income--such as from shipping and foreign refineries.

This legislation will move existing tax laws closer to the intent expressed by Congress in 1975 and 1976. The tax treatment now available to oil companies is not needed for continued exploration and production.

The Department of Treasury is also reviewing regulations in order to tighten the foreign tax credit for oil and gas income. Treasury will establish tighter regulations for distinguishing bona fide foreign income taxes, which may be credited against United States income taxes, from royalties and excise taxes which may be taken only as deductions.

Enhanced Oil Recovery

Over the long run, additional investments in enhanced oil recovery may be as critical as discoveries of new fields in meeting U.S. oil needs. Primary recovery (from reservoir pressure) and secondary recovery (from water injection) can only capture about a third of the oil in place. In the U.S. alone, some 300 billion barrels will remain in place after past and current production of known resources. Enhanced oil recovery has the obvious potential, therefore, to expand the size of the Nation's recoverable domestic reserves.

Actions to decontrol domestic crude oil prices will offer greater incentives for enhanced oil recovery. New production from certain enhanced recovery techniques (such as tertiary recovery) will be entitled to the world oil price, beginning June 1, 1979. Soon thereafter, beginning January 1, 1980, producers will be allowed to "release" specified volumes of lower-tier oil to the upper-tier price to help finance their investments in enhanced oil recovery projects.

Finally, the Department of Energy is jointly funding with industry various R&D projects in enhanced oil recovery. The Department's budget authorizes $54 million in FY 1979 and $21 million in FY 1980. However, industry will have additional funds for field testing in FY 1980 and 1981 through the release of lower tier oil prices to upper tier levels.

Table IV-4 describes the major enhanced oil recovery techniques and the projected incremental production from such techniques. The costs, technical efficiency and commercial viability of these individual technologies vary, as well as their environmental impacts. Each faces its own specific problems.

TABLE IV-4

ENHANCED OIL RECOVERY

Process	Potential Production Above Current Levels (thousand barrels per day) 1985	2000
Thermal (Steam Recovery and In-Situ Combustion)	300-700	450-1150
Carbon Dioxide Injection	95-110	110- 280
Chemical	0- 20	50- 150
TOTAL	400-800	600-1600

- o Steam Recovery - Steam recovery techniques, which heat and dilute the oil to make it flow, have had their primary use in California in the production of heavy crude oils. Steam recovery accounts for most of the 370,000 barrels per day now attributed to enhanced recovery. The burning of crude oil to generate steam causes air pollution problems. The Department of Energy is supporting various R&D efforts, including use of solar energy to generate steam, to remedy this problem.

- o In-Situ Combustion - This second thermal recovery technique burns some of the crude oil in place to heat the remaining oil. This eliminates the need to burn fuel on the surface to generate steam. However, technical problems--such as controlling the movement of the underground fire and the venting of combustion gases--call for further R&D.

- o Carbon Dioxide Injection - When injected into a well, carbon dioxide or other gases mix with oil and help flush it from the formation. This technology, though in limited use now, will have wider use as world oil prices increase and suitable gases become more available.

- o Chemical Processes - Certain chemicals, such as detergents, caustics, and polymers, make water more effective in flushing out the oil. This longer-term, higher-cost recovery option requires further R&D, but has the potential for widespread use, if the contamination of water tables can be avoided.

Development of Unconventional Oil Hydrocarbons

Various unconventional hydrocarbons are available--notably heavy crudes, oil shale and coal--to produce liquid fuels. These unconventional oil sources could substitute for oil in massive quantities at higher levels of world oil prices.

Heavy Crudes--Conventional crudes range from very light, easily flowing oils to the heavier crudes, such as those found in California, which require thermal enhanced recovery technology. Even heavier, more viscous crudes are found throughout the world. Some are so heavy that they have to be mined rather than heated and pumped to the surface.

The U.S. has extensive heavy crude resources--on the order of 100 billion barrels--especially in California. Actual recoverable reserves hinge on technology, production costs, oil pricing, and the development of markets. They probably would not be tapped until the more conventional heavy California crudes are used and after the marketing and environmental problems are resolved.

Venezuela has a huge resource, an estimated 750 to 3,000 billion barrels of very heavy Orinoco crude. If only 5 to 10 percent of the oil-in-place were found to be recoverable, it would still make a significant addition to world reserves. The estimated cost of producing and refining this crude varies--between $10 and $20 per barrel. The cost depends in part on the technology used to deal with the high heavy metals content in the oil.

Tar Sands--Oil can also be extracted from tar sands, which are similar to heavy crude deposits. Canada's Athabasca tar sands deposits have been estimated at 250 billion barrels of resources-in-place. The amount of oil that can be actually recovered is still not known. One company has been producing about 50,000 barrels per day since 1966. Another plant built by a different group began operation in 1978. The cost of producing this oil and upgrading it for use in a conventional refinery is $7 to $16 per barrel. Production levels will depend on the price and the markets--and on the pace at which Canada decides to develop its remote Athabasca region.

The U.S. has tar sand deposits also, mainly in Utah, and these are estimated at 30 million barrels of resources-in-place. Perhaps 2 to 5 million barrels are recoverable. In general, these deposits are low-quality (less oil per ton of sand), and are more costly to produce than conventional crude oil or Canadian tar sands. Production of oil from tar sands requires extensive mining and heating (i.e., retorting) operations, that give rise to air pollution and solid waste disposal problems. Such deposits have not yet been developed outside Canada.

Oil Shale--The U.S. has a hugh oil shale resource, located primarily in Colorado, Utah, and Wyoming. These States contain approximately 400 million barrels of high-grade resources-in-place. Perhaps up to 80 million barrels could be recovered with use of proven technologies.

The President has proposed a limited $3.00 per barrel oil shale production tax credit to be financed from the Energy Security Fund. The tax credit would provide the economic incentive for industry to demonstrate commercial oil shale production by the mid-1980s, using the most economically and environmentally promising technologies. The tax credit will begin to phase out when world oil prices reach $20 per barrel (corrected for inflation) and will completely phase out at $23 per barrel. Production levels could be as high as 300,000 barrels per day in the 1990s, if the oil shale technologies prove adequate on economic and environmental grounds.

In addition to the tax credit, the Department of Energy will continue R&D programs, at slightly decreased levels, into various oil shale production technologies. In addition, two large oil shale projects on Federal lands are already underway, and will provide critical information about the environmental problems and impacts of oil shale production. Initial results are anticipated from these projects in the 1981-82 time frame.

Several methods exist to recover oil shale. Oil shale can be mined above ground; it can also be heated in natural underground retorts (modified in-situ); and finally, it can be heated in place underground (true in-situ). Several companies have been assisted by the Federal government to conduct pilot-scale tests of different oil shale technologies, but production costs of these technologies remain uncertain.

Environmental problems raise another set of uncertainties. The retorting of oil from shale creates air emissions and large amounts of solid waste. "In-situ" production techniques can disrupt or contaminate water tables, and toxics from the production process threaten worker health and safety. These and other problems have discouraged companies from making large scale investments in oil shale technology. Without the tax credit, oil shale production on a commercial scale might not begin until the late 1990's.

It is the Administration's view that R&D programs and prototype plants assisted by the tax credit will develop the necessary technical, environmental and economic information on which to base a decision to build a domestic oil shale industry.

Coal Liquids--Conservation, enhanced oil recovery, oil shale and direct burning of coal are expected to play considerably larger roles than coal synthetics in reducing demand for imported oil in the near and mid terms. The technologies are at hand, or nearly so, and production costs are lower. Liquid fuels manufactured from coal, however, could provide a potential backstop to substantial increases in world oil prices, since they come from a vast and well-known U.S. resource base.

Two different production technologies are available--direct and indirect liquefaction. Direct coal liquefaction, as the name implies, involves direct reactions of hydrogen and coal and yields heavy, middle, and light distillate liquids. The primary products are relatively heavy, and can substitute for residual fuel oil. About 20 to 40 percent of the output, however, is middle distillate and lighter quality fuel.

Indirect liquefaction, on the other hand, first gasifies the coal and then from the gas produces gasoline or light coal liquids. Production of light coal liquids is expected to cost more than unrefined coal liquid boiler fuels, but the market value of distillates and gasoline is higher.

The primary environmental concerns from coal liquefaction are potential exposures to carginogens, toxic compounds during the production, the site-specific impacts in water-scarce and poor air quality regions. These concerns, however, are likely to be different for the direct and indirect liquefaction processes. With the indirect process, the coal structure is destroyed by the gasification. The risk of exposures to potentially carcinogenic and toxic compounds therefore decreases. With the direct liquefaction process, the coal structure is not completely destroyed. Potentially carcinogenic materials are present during the intermediate process, and possibly in the final product.

The Administration's objective is to demonstrate the capability to produce synthetic liquids from coal by the mid 1980s, so that significant capacity could be built in the 1990s if oil prices rise sharply.

The Department of Energy is supporting a number of RD&D projects for coal liquids. Included are two demonstration projects for solvent refined coal, one producing solid products and the other liquids to displace residual fuel oil. Preliminary designs are being prepared for both and a decision on how to proceed will follow later this year.

The Department is supporting two other direct liquefaction processes that are now in the pilot plant stage--Exxon Donor Solvent (EDS) and H-Coal. Also underway are limited efforts to demonstrate the capability to convert heavy coal liquids into distillate quality fuels, and to develop alternative methods for producing lighter liquids such as gasoline and distillate fuels from coal. The primary objective of all of these projects is to resolve technical and economic problems, but they also generate information on the environmental, safety and health impacts of the technologies.

Ethanol Fuels--One other unconventional source of liquid fuel is biomass--agricultural products, forest residues, and similar matter produced by photosynthesis. Biomass-derived fuel, particularly ethanol, is currently being marketed in the form of "gasohol" (a mixture of 10 percent ethanol and 90 percent gasoline). Gasohol has recently sold well in the Midwest, at prices competitive to premium unleaded gasoline. The ethanol component of gasohol currently costs about $1.15 per gallon (equivalent to $1.50 per gallon of gasoline on a Btu basis). Its value as an octane booster and the scarcity of petroleum-derived alternatives helps to overcome this cost-disadvantage.

By exempting gasohol from the 4 cents per gallon Federal gasoline tax, the NEA provides ethanol production with a subsidy equivalent to $16.80 a barrel.[1] Several States also offer motor fuel tax rebates for gasohol. With these subsidies, gasohol sales have risen rapidly--from nearly zero a year ago to a rate exceeding 8 million gallons per year of alcohol by February of this year.

Since the NEA tax exemption for gasohol would expire on October 1, 1984, new ethanol production facilities are not being planned or built. The President has therefore proposed to extend this exemption to provide an incentive for investments in new facilities. By 1990, ethanol production could reach 60,000 to 120,000 barrels of oil-equivalent per day.

The unconventional hydrocarbon fuels discussed here--oil shale, coal liquids and ethanol--could all serve as liquid fuels and substitutes for imported oil. However, at current world oil prices, they are not

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1/ Each gallon of gasohol contains 10 percent ethanol; a "barrel" of ethanol contains 42 gallons.

competitive or ready for commercial use. The strategy includes policy actions specifically designed to stimulate each of these fuels. The President has directed the Department of Energy--working with other appropriate agencies--to devise additional policy actions that will encourage the private sector to develop the hydrocarbon technologies further. By financing such programs, the Energy Security Fund could provide long-term solutions to U.S. liquid-fuel needs.

B. Natural Gas

SUPPLY OUTLOOK

Recent History--Until passage of the Natural Gas Policy Act of 1978 (NGPA), the current decade had been a period marked by massive curtailments in the interstate markets. The dual existence of a price-controlled interstate market and an uncontrolled intrastate market led to distorted allocations of gas supply. The natural gas industry in the U.S. has grown rapidly since World War II. Low prices, plentiful supplies, environmental problems with other fuels, and the creation of an extensive interstate network of pipelines that served new markets made natural gas the country's most desirable, premium fuel by the late 1960s.

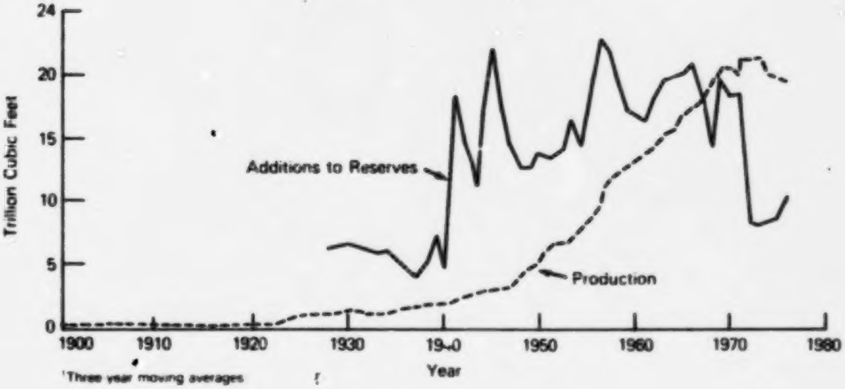
But the Federal regulatory system proved unworkable when market conditions rapidly changed, and interstate demand began to exceed the price-controlled supply. Gas prices rose even in the interstate markets, despite Federal regulation, but not sufficiently to match increases in the intrastate markets, or bring the total national demand in balance with national supply.

Meanwhile, natural gas utilities maintained traditional policies of average-cost pricing to their customers, at a time when the prices for new gas supplies were rising rapidly. Due to such policies, customers did not face the true incremental cost of additional gas consumption, lacked incentive to conserve, and continued to demand more gas. Since price could not be used to balance demand and supply, Federal and State authorities attempted to reduce demand by curtailments of service. Curtailments, which affected almost no one in 1969, increased to more than three trillion cubic feet (TCF) annually by the mid-1970s.

During the 1970s, Federal price controls on interstate gas had the effect of diverting up to 85 percent of new natural gas supplies to intrastate markets in which prices were increasing without restriction. Industrial users in the interstate markets, the lowest-priority users in curtailment plans, could not purchase reliable gas supplies, and shifted to oil. State and Federal authorities also restricted new gas hook-ups to residences and commercial buildings. Existing regulation had thus led to gas surpluses in intrastate markets and shortages and greater use of imported oil in interstate markets.

While Federal regulation helped keep natural gas markets in chronic imbalance, total U.S. natural gas production had peaked at 21.6 TCF in 1972 and begun to decline. As Figure IV-4 shows, additions to U.S. gas reserves since the mid-1960s have fallen far short of high U.S. production levels--except in 1970, when Alaskan North Slope supplies were added to U.S. reserves. The Figure indicates that in the past two years, additions to reserves have turned up slightly after a steep decline. Rising gas prices, especially in intrastate markets, have brought an increase in U.S. gas drilling. These higher rates of addition may be a temporary variation rather than a long-term trend. In 1978, total domestic marketed production stood at 19.7 TCF, an amount that has been relatively constant over the past four years.

Figure IV-4
Additions to Natural Gas Reserves[1]
and Production of Natural Gas



[1] Three year moving averages

The Natural Gas Policy Act--Last year's enactment of the NGPA has changed the gas supply outlook dramatically. The NGPA has abolished the dual market system, and set a course toward gradual decontrol of gas prices in 1985. Scheduled increases in new gas prices will give U.S. producers a firm planning horizon within which to develop new supplies. To stimulate greater production now, the Act also deregulates certain high-cost conventional supplies (e.g., from wells below 15,000 feet) within one year of enactment.

The Act sets price ceilings for a number of different categories of gas. The price ceiling system is designed to provide the highest incentives for more risky exploratory drilling, while restraining price increases on previously discovered gas to prevent significant inflationary impacts. All unconventional gas supplies will receive deregulated pricing treatment--including gas from geopressurized brine, coal seams, and Devonian shale. The Act also facilitates the sale of Alaskan natural gas by fixing its price and allowing transportation charges to be "rolled-in"--that is, shared equally by all the customers in a utility's system--rather than priced incrementally to a few.

The NGPA generally protects residential consumers from higher new-gas prices by requiring some portion of these prices to be passed through first to industrial users. This incremental pricing rule will not result in industrial gas prices higher than the regional cost of substitute fuels as determined by the Federal Energy Regulatory Commission (FERC).

In addition, the NGPA provides for emergency authorities to ensure continued supplies for high priority users and protect essential agrucultural users and industrial feedstock users from curtailment of gas supplies.

Other parts of the NEA will also influence the gas supply outlook in the U.S., especially the use of gas in particular sectors. The Fuel Use Act prohibits use of natural gas in new utility and large industrial boilers unless exemptions are granted by the Department of Energy; however, it does allow unconventional gases to be used as new-boiler fuels. The NEA also denied investment tax credits and accelerated depreciation for new gas boilers. Along with the incremental pricing provisions of the NGPA, these tax penalties will function as a deterrent to new boiler uses of gas. Finally, the Public Utilities Regulatory Policies Act authorizes the Department to intervene in gas rate-making proceedings to encourage energy conservation.

The provisions of the NGPA should add approximately 2.8 TCF to 1985 production, including .9 TCF of Alaskan gas. The Act has immediately made available up to 1 TCF of surplus gas, which had formerly been pent-up in intrastate markets. As Table IV-5 indicates, there is substantial uncertainty about the long-term estimates for U.S. gas supply and demand. In general, demand through the 1980's will be flexible because some industrial and utility boiler-fuel users are capable of switching from gas to alternate fuels, such as residual oil or coal. Under these circumstances, conventional lower-48 production can meet residential, commercial and premium industrial demands.

STRATEGY FOR NATURAL GAS

The strategy for natural gas must build on the accomplishments of the NGPA. The strategy must recognize that gas supplies are ample to meet existing demand in the near term and provide for at least some new buyers as well. Over the mid- and long term, however, the amount of conventional supplies, alternate and imported suplies, and unconventional production available to meet U.S. needs will be extremely uncertain. Careful judgments will be needed about the benefits and costs of additional gas use from a variety of sources. Pursuant to this strategy, the U.S. will--

- seek the maximum benefit from the temporary gas surplus by encouraging dual-burning utility and industrial facilities to shift from oil to natural gas and thereby reducing imports of oil;
- implement the provisions of the NGPA to encourage maximum exploration and production of domestic natural gas, and ensure new markets for these additional supplies in residential, commercial and industrial markets; and
- develop and encourage supplemental sources of gas supply that are reasonably priced, do not displace lower cost domestic supplies and are not unreasonably vulnerable to disruptions.

Temporary Gas Surplus

When it became apparent that a temporary gas "bubble," or surplus would arise from elimination of the dual market structure, the Department of Energy sought to reverse the trend among certain industrial and utility users who had been shifting from gas to fuel oil. The Department has announced that it will grant temporary exemptions from the Fuel Use Act to allow gas burning for up to five years, and it has publicly encouraged industries to shift from oil to gas. The oil import savings available from voluntary oil to gas switching could range up to 400,000 to 500,000 barrels per day.

TABLE IV-5

NATURAL GAS SUPPLY AND DEMAND[1]
(quads/year)

	1977	1985	2000
SUPPLY			
Conventional Lower-48	19.5	16-18	12-14
Alaska	.1	.8-1.0	1-2
Unconventional[2]	-	.3-.8	1-5
Synthetics[3]	-	0-.1	1-2
Other[4]	.3	.2-.5	.2-.5
Total	19.8	18-20	16-22
Imports	1.0	1.8-2.2	1.5-2.0
Net Withdrawals[5] from Storage	-.6	-	-
Total Supply	20.3	20-22	18-24
CONSUMPTION			
Residential and Commercial	7.6	7-8	8-10
Industrial[6]	8.8	10-11	10-13
Other[7]	3.9	2.5-3	.6-.7
Total Consumption	20.3	20-22	18-24

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[1] Projections represent uncertainty from geology, costs, and market supply, demand and price considerations. Totals may not add due to rounding.

[2] Includes new production only from tight sands, Devonian shale, coal bed methane, or geopressurized methane.

[3] Includes production of medium and high-Btu gas from coal.

[4] Gas manufactured from naptha and natural gas liquids (SNG).

[5] Withdrawals from storage are assumed to balance injection to storage in these projections.

[6] Includes refinery and raw material gas demand.

[7] Includes gas for electricity generation and pipeline fuel.

The Administration remains committed to using coal instead of oil or gas in new boiler facilities. Over at least the next several years, however, existing industrial and utility facilities that can burn both oil and gas will be encouraged to burn gas. Where the shorter term industrial or utility choice is between oil and gas in existing facilities, gas should be used. Draft regulations for implementing the Fuel Use Act incorporate this critical priority to ensure that surplus gas supplies displace foreign oil.

The excess supply of gas made available by passage of the NGPA is, by its very nature, a transient phenomenon. For that reason alone, it is not an appropriate source of supply on which to base decisions about new residential hook-ups, especially since these hook-ups would require long-term investments.

New Markets

Development of conventional domestic gas supplies will receive the highest priority in the Administration's natural gas strategy. Markets for new gas should be assured to eliminate any potential chilling effect on higher rates of drilling, which might negate the new incentives in the NGPA. It is the Administration's view that gas can and should continue to serve premium markets, such as residences and commercial establishments. Beyond that, available supplies should be used to displace foreign oil--particularly distillate--whenever and wherever possible.

Within recent months, most States have relaxed restrictions on new hook-ups to residential consumers. Encouragement of new residential gas hook-ups would open additional markets for domestic gas production and provide a lower-cost fuel option for consumers. For consumers, the benefits are obvious. The costs of home heating from gas are less than the costs of home heating from the major alternatives, electricity and oil.

As noted above, existing industrial facilities with dual oil-and-gas burning capabilities should utilize fully the temporary gas over-supply. New industrial facilities that cannot use coal should at least develop a dual-burning capability, and burn gas rather than oil when it is available.

Supplemental Gas Supplies

Supplemental gas supplies should not be permitted to discourage the development of lower-48 gas production. Total annual production from conventional sources in the lower-48 States could be maintained near current levels through 1985. Additional finds from unexplored and deregulated deep zones below 15,000 feet could substantially expand U.S. proven reserves by as much as 100 TCF, further enhancing domestic production. Supplemental gas sources should be judged on their respective costs and benefits to the Nation.

Alaska gas--It is apparent that the Nation can use all the reasonably priced domestic natural gas it can produce. The Prudhoe Bay field contains proved saleable gas reserves of 20.6 to 22.8 TCF. The likelihood of substantially greater reserves of gas in this area makes the case for access to and use of the known reserves even more compelling.

The Alaska gas transportation system, designated by the President and approved by the Congress, will bring Alaskan gas to the lower-48 through Canada, then divide into separate "legs" that will serve the Far West and Midwest. The pipeline will span 4,790 miles in length, and would be ready in late 1984. The pipeline could have an operating life of at least 20 and possibly 30 to 50 years. By the mid to late 1980s, Alaskan gas could contribute about .9 TCF annually to U.S. production, adding about 5 percent to total domestic supply annually. Even allowing for an unlikely 90% cost overrun, the net national economic benefit advantage of the Alaskan project as compared to any gas project tied to the world price of oil is $5 billion dollars over a 20 year project life.

Natural Gas Imports--Imported gas from Canada and Mexico can be attractive sources of supply at medium cost--with reduced balance of payments impacts. The U.S. has long imported natural gas from Canada--an average of 1 TCF annually in recent years. Although no natural gas is being imported from Mexico at present, the recent large discoveries on Mexico's east coast provide a basis for possible future imports.

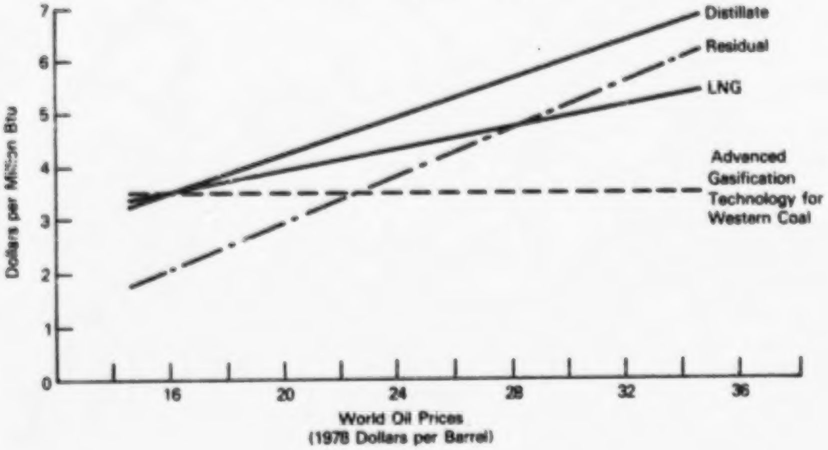
The U.S. would welcome additional supplies from these sources--to the extent they are reasonably reliable, are priced attractively enough to maintain a market in the U.S. and do not force the shutting-in of domestic production. If priced competitively, gas imports can usefully supplement domestic production. The U.S. should not commit itself to imported gas supplies that have long-run costs significantly greater than the costs of alternate fuels to marginal gas users. The only circumstances under which such gas supplies could be marketed would be through rolled-in pricing with lower-cost domestic supplies.

During President Carter's trip to Mexico in February, he and the President of Mexico agreed to resume government-to-government discussions on potential sales of Mexican natural gas to U.S. markets. A team of U.S. officials has already met with Mexican government officials to consider how much gas will be available for export and the appropriate pricing of that gas. The President expects that a framework for natural gas trade can be developed which will allow interested U.S. companies to purchase Mexican gas at a price fair to both countries, and which will strengthen the continuing energy relationship between the U.S. and Mexico.

Liquefied Natural Gas--Short-haul and long-haul liquefied natural gas supplies (LNG) are somewhat less attractive sources of supplemental gas. LNG from overseas is more vulnerable to interruption and higher in cost than overland gas imports from Mexico or Canada. While normal operations have little environmental impact, concerns over potential large-scale accidents have led to continuing public and occupational safety examinations. Finally, LNG projects have so far proved attractive to the firms involved only because of numerous subsidies--such as averaging LNG costs with domestic supplies, direct subsidies to LNG tankers, and low cost Export-Import Bank loans.

The U.S. imports limited amounts of LNG from Algeria into the East Coast. Recent applications for two more long-haul LNG projects from Algeria, however, were rejected by the Department on economic grounds. Approval criteria hinge on the specific costs of individual projects, contract terms, and safety and reliability issues. Figure IV-5 illustrates the relationship between world oil prices and the prices of LNG and coal gasification. If attempts to tie LNG prices to world oil prices succeed, American consumers would have to pay for unusually high-cost gas, while less expensive domestic sources were shut in.

Figure IV-5
Real Resource Costs of Supplemental Pipeline Gas Supplies



Unconventional Gas Sources--Three unconventional domestic sources of gas--tight sands formations in the West, Devonian shales in the East, and coal bed methane--are already in commercial use in limited quantities. A fourth--geopressurized methane--is further from such use. Table IV-6 shows the estimated recoverable resources of these four unconventional gases.

Approximately 1 TCF of unconventional gas--all of it from tight sands formations in the West--is commercially available today at competitive prices. Table IV-6 shows the incremental production that can be expected from the unconventional gases in 1985 and 2000. The vast share of this additional production will be gas from tight sands. This new supply will meet industrial process, feedstock and transportation uses, as well as demands in the residential and commercial sectors.

In addition to tight sands, increased production is likely in the midterm from Devonian shale and coal-bed methane. Since these gases can be recovered with existing technology, the economics may now be attractive in certain local markets for industry and community development. In the larger interstate markets, the economics of production are still not favorable.

TABLE IV-6

UNCONVENTIONAL GAS RESOURCES

Source	Estimated Resource Base (Tcf)	Potential Production Above Current Levels (thousand barrels per day) (Tcf/year)	
		1985	2000
Tight Sands Formations	50-420	0.35-0.8	1.3-5
Devonian Shale	25-400		
Coal Bed Methane	50-700		
Geopressurized Methane	5,000-63,000		

Although production of geopressurized methane calls for new technology, the resource offers the potential for extremely large long-term gas supplies. The geopressurized gas is dissolved in large quantities of hot, high-pressure water from deep formations in the Gulf Coast region. The water must then be brought to the surface, and the gas removed.

The Administration is following several approaches to develop unconventional gas supplies. First, the deregulated pricing treatment for such gases established by the NGPA is expected to speed private commercial development of these resources. Second, the exemptions for boiler use of such gases in the Fuel Use Act creates a special industrial market for unconventional supplies.

Third and finally, the Department of Energy will conduct R&D and fund a limited number of demonstration projects, with local government and industry, to improve recovery rates and lower costs. For geopressurized methane, the effort also includes well drilling to establish the real potential of the resource and to solve a number of technical and environmental problems, such as salt water disposal.

The large quantities of gas in place for each of these unconventional resources, along with changes in market conditions, justify strong efforts to develop them.

Coal Gasification--High-Btu gas from coal is another potentially large domestic energy source. It could be produced with Lurgi technology already developed and commercialized abroad, but not yet in commercial operation in the United States. Several U.S. industrial firms have proposed to build large Lurgi plants using Western non-caking coals. Availability of capital and high marketing risks due to the higher production costs compared to costs for conventional supplies present the major barriers to commercialization of high-Btu gas. These problems, in turn, have been exacerbated by uncertain Federal regulatory policies. Unless these barriers can be removed, timely production of high-Btu gas will not occur.

The Administration supports private sector initiatives to commercialize coal gasification to supplement the Nation's supply of gas. The President has asked the Department of Energy to continue its assistance in minimizing the regulatory, financial and institutional barriers involved in such development. For example, the Department of Energy has supported the formation of the Great Plains Coal Gasification Project consortium to build and operate a commercial-size coal gasification facility in North Dakota.

The government has funded RD&D on more advanced coal gasification technologies for many years. These advanced technologies aim to extend the applicability of high-Btu gasification to eastern caking coals and lower the costs of conventional Lurgi. Several process-development units and pilot plants have already been built as part of this program. The Department of Energy is considering funding--jointly with industry--a large scale commercial demonstration plant based on one of these technologies. The decision will consider the relative costs of the gas made from projects with that from the conventional Lurgi process as well as from conventional and unconventional domestic sources.

C. Conclusion

The strategy must recognize the close relationship between oil and gas and the ease with which gas can substitute for oil, especially in the industrial sector. Success in developing more gas supplies can translate into direct reductions in oil imports. Higher gas consumption can offset oil imports essentially on a Btu-for-Btu basis. Over the mid-term and beyond, the strategy must be continuously sensitive to the price and availability of unconventional liquids and gases that can substitute for oil.

Because of market complexities, the uncertain economics of new technologies, possible fluctuations in conventional gas supplies, and continuing changes in the world oil markets, the oil and gas strategy outlined in this Chapter will not be easy to implement. But careful and timely judgments about the need to deploy new technololgies will be critical to the Nation's political and economic security in the years ahead.

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CHAPTER V

COAL AND NUCLEAR: THE TRANSITIONAL ENERGY SOURCES

Coal and nuclear power now supply 22 percent of the Nation's energy and must provide an increasing share as conventional oil and gas resources are depleted. Over three-fourths of domestic coal consumption and virtually all of the nuclear energy is now used to generate electric power, with oil and gas dominating transportation, space heating, and most industrial uses. Although the Administration is encouraging the direct use of coal in industry, electric generation will continue to be the chief use of both coal (and nuclear energy) for at least the next 40 years. The growth in consumption of coal and nuclear depends in large measure on their environmental and public acceptability, and their competitiveness with one another and with new technologies yet to come.

Both of these energy sources face two basic challenges:

- the need to resolve institutional and environmental problems that limit the use of existing direct coal-fired and light water reactor plant technology; and
- the timing and pace of development of more resource-efficient technologies, such as advanced coal-fired power cycles, alternative nuclear fuel cycles, and advanced nuclear reactors.

The first challenge is one of technology survival rather than economics. Unless direct coal burning and light water reactor power plants can achieve environmental and public acceptability, they will not be able to carry their projected share of new electric power generation. If either one falters, then the other will have to grow that much faster, further aggravating its own difficulties. And without competition from the other, the added pressure placed on the remaining source will drive its costs higher.

The second challenge--technology development--depends on the outcome of the first and on the growth in electricity consumption and development of other new energy sources. The role for technologies such as Magnetohydrodynamics (MHD), coal fuel cells, and the liquid metal fast breeder reactor will depend on how expensive they are compared to alternatives.

In the years since the embargo, perceptions of the role for these technologies have changed radically. Electricity consumption, which has doubled every decade (7 percent per year) for more than half a century, is now expected to rise more slowly. The growth rate should approach about half the historic average by the end of the century. This slower growth in demand, though welcome for many reasons, has seriously disrupted utility construction planning, particularly for nuclear plants. On the other hand, the slower demand growth will postpone the potential depletion of uranium resources, avoids greater environmental problems from more coal use, allows more time to develop new technologies, and removes any urgent need to commercialize the breeder reactor.

A. Coal

During the first half of this century, coal was the predominant fuel in the United States. In the late 1940s, however, its dominance began to erode as consumers shifted to cleaner, more convenient, and frequently cheaper energy forms -- primarily oil and gas. Figure V-1 shows how the use of coal changed both as a fraction of total energy use and in physical terms.

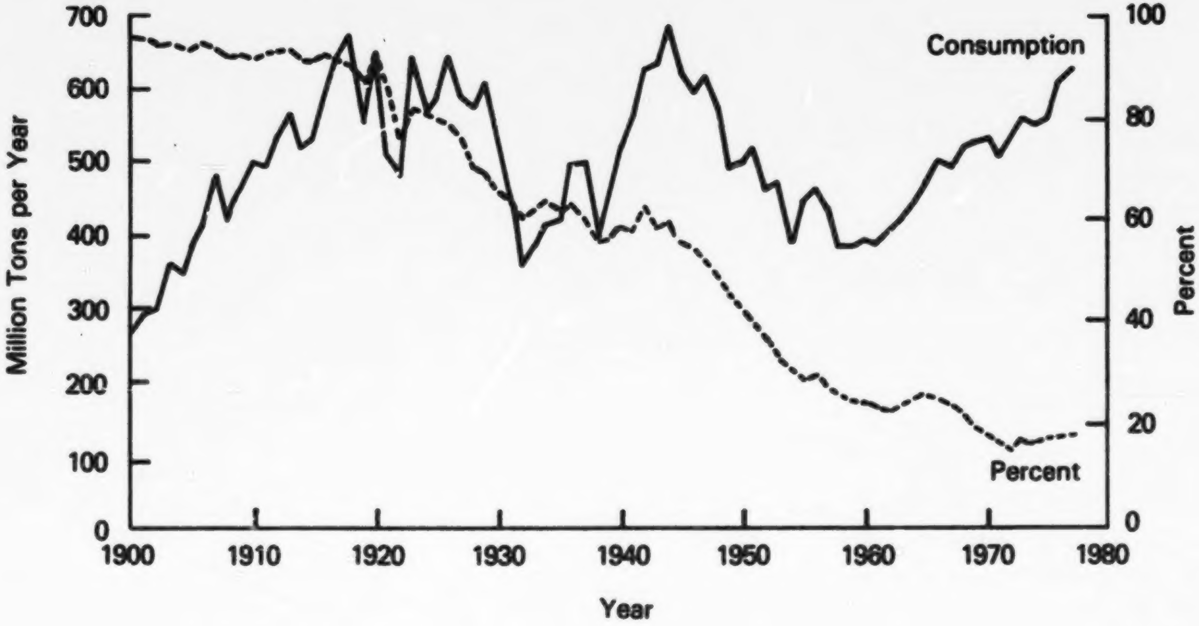
For many years, coal was a dominant fuel in all demand sectors, including transportation, in which it supplied the railroads. As coal declined in the 1950s, and even when it revived again in the late 1960s and 1970s, it came to depend on one major market--utilities. In 1978, 78 percent of the coal used in the U.S. was burned by the electric utilities.

Even today, however, U.S. coal reserves are still hundreds of times greater than annual production levels. While domestic oil and natural gas use is limited by supply, coal consumption is limited primarily by constraints on demand. Even when the fuel cost economics favor coal, firms have been willing to pay sizable premiums for cleaner, more convenient fuels.

Many people remember the time when clouds of smoke hung over U.S. cities. People also remember production disruptions, such as coal strikes, which threatened the entire economy. Coal mining has historically been a dangerous calling, and the health and safety of miners an urgent social concern. Even if past problems do not recur, the attitudes that were created by these problems may persist.

In the past 15 years, coal's environmental problems have been curbed by Federal and State actions dealing with air and water pollution, underground mine health and safety, and, most recently, surface mining and reclamation. However, utilities and industry often found it easier to meet new air emission rules by switching to oil, gas, and lower sulfur coals, than by installing pollution control equipment.

Figure V-1
U.S. Coal Consumption as a Fraction of Total Energy Consumption



Mining safety regulations helped reduce fatalities and disabling injuries in both underground and surface mines, but worker productivity necessarily fell, and labor costs rose (especially in underground mining). Partly because of increased safety costs and other economic reasons, there has been a shift from underground to surface mining. As the new Surface Mining and Reclamation Act is implemented over the next few years, however, the costs of surface mine production may also begin to rise. Meanwhile, concern with another problem of fossil fuel use, especially coal use, has been growing -- the accumulation of carbon dioxide in the atmosphere from coal combustion, which might raise temperatures and affect the earth's climate.

STRATEGY FOR COAL

The U.S. has nearly 4 trillion tons of coal in place, and has economically recoverable reserves that approach 200 to 300 billion tons. But annual production of coal has risen to only 660 million tons per year. The Administration seeks to increase production and encourage greater reliance on coal. To carry out this strategy, the U.S. will:

- o Expand domestic coal markets by vigorously implementing regulations that prohibit the use of oil and gas in utility and large industrial boilers, under the Powerplant and Industrial Fuel Use Act of 1978.
- o Encourage the development of better emission control technologies so that both existing and new utility and industrial facilities can burn coal directly and still comply with current and antici-cipated environmental standards.
- o Demonstrate the capability to produce synthetic liquids and gas from coal by the mid 1980s so that significant capacity can be built in the 1990s--if increasing world oil prices make them competitive.
- o Develop technologies that will allow a more efficient and environmentally acceptable use of coal in the 1990s and beyond.
- o Improve the competitive economics of coal by correcting oil and gas price distortions; develop cheaper ways to mine coal in an environmentally acceptible manner; and discourage increases in coal prices that do not reflect real increases in the cost of producing and delivering coal.

The program for coal emphasizes direct coal combustion, since about 90 percent of the coal consumed in this country in the next 20 years will be burned directly. Coal gasification, liquefaction, and other advanced technologies will probably not account for a large share of coal use before 2000.

Coal Conversion Regulations

The Energy Supply and Environmental Coordination Act of 1974 (ESECA) provided the authority to require coal use in boilers capable of burning coal. The National Energy Act extended and improved on the ESECA authority through the Powerplant and Industrial Fuel Use Act, which authorizes a variety of regulations for requiring existing and new boilers to use fuels other than oil or gas. In particular, utility and large industrial boiler users may be prohibited from burning oil or gas in new units unless they show that they cannot use coal or another alternative fuel. Regulations under the statute will be promulgated shortly and will indicate how much more costly coal use must be before an exemption to use oil or gas is granted.

The Department of Energy intends to use its statutory authority vigorously, and thereby reduce oil imports by an estimated 300,000 to 450,000 barrels per day by 1985. The Department is also working with other agencies to assure that other Federal regulations, policies, and programs do not needlessly hamper utilities and industry from converting to coal.

One provision of the Fuel Use Act deserves special mention. Before certain exemptions can be granted, it must be shown that use of coal-oil mixtures is not feasible. These slurry-like mixtures contain pulverized coal and oil. They can be burned as liquids in an oil-fired furnace -- either in existing oil burning facilities when it is not feasible to convert exclusively to coal, or in new facilities when exclusive use of coal is foreclosed for environmental reasons.

The technical feasibility of such mixtures has been demonstrated only for short periods. More information is needed on long-term performance, the range of applications, and especially on the ability to transport and store the slurries. If the mixtures could be produced at a central plant and shipped to a variety of users, they could be used more widely than if they had to be produced on site. Current testing programs should answer many of these questions.

Environmental Problems of Coal Combustion

Compliance with environmental standards poses the greatest potential constraint on increased direct use of coal. Unless these standards can be met at competitive costs, many firms that might use coal will turn to other fuels instead. The Department of Energy has accelerated its efforts to develop new technologies for improved emissions control. The Department is working with the Environmental Protection Agency (EPA) and other agencies to develop appropriate control strategies for complying with environmental regulations. The future of coal conversion depends in large measure on the success of these efforts.

Although coal utilization is affected by many environmental standards, air pollution is the major problem. Some of the water pollution and solid wastes problems affecting coal use arise from the techniques used to reduce air emissions from coal combustions.

The air pollution control standards that individual utility and industrial coal-burning plants must meet depend largely on the age and location of the facility. Most plants that existed in 1975 must meet the emission standards in the Clean Air Act's State Implementation Plans (SIPs). New facilities must meet New Source Performance Standards (NSPS), which are currently being revised. Those new facilities for which construction was started before September, 1978, must meet the existing NSPS standards. Facilities for which construction began later will have to meet the forthcoming NSPS standards and the still undefined new requiments for visibility maintenance. By 1985, less than 15 percent of coal burned in the U.S. will be affected by the revised NSPS, but by 1990 more than one third will be subject to the new standards. In addition to these minimum standards, special permitting procedures are required by the Clean Air act that will lead to tighter controls in pristine areas and in areas not attaining health standards.

Air Pollutant Risks -- Coal combustion emits a variety of air pollutants that may damage the environment and public health -- including sulfur dioxide, nitrogen oxides, particulates, hydrocarbons, and carbon monoxide. Compliance with existing sulfur dioxide emission standards is the most costly. Closely related and possibly even more difficult to regulate and control are the sulfates formed from sulfur dioxide and particulate matter. Sulfates may have significant effects on human health and ecology. They can be transported several hundred miles in the atmosphere and then "washed out" in the form of "acid rains," which adversely affect both plants, animal life, and humans. Together, sulfur oxides and sulfates are likely to constitute the single most important near-term constraint on direct coal use.

Nitrogen oxide emissions depend on the amount of nitrogen in the coal, and the combustion conditions that can convert nitrogen in the air into nitrogen oxides. Coal contains more nitrogen than other fuels, aggravating the general fossil fuel problem. Special combustion techniques can reduce nitrogen oxide emissions slightly. But major new technologies, such as "post-combustion" controls, will be necessary if reductions in nitrogen oxide emissions from stationary sources are needed.

Particulate emissions can be effectively reduced with current technologies such as electrostatic precipitators. But current technologies are not as effective for the very small, respirable particulates most closely associated with health and visibility effects. These small particulates act as carriers for trace elements and hydrocarbons, many of which may be toxic or carcinogenic. Alternative controls, such as "bag houses," may be needed to reduce respirable particulate emissions. Such controls have not yet been used widely by utilities.

Water pollution and solid waste problems have plagued coal use for many years. More stringent standards set by the Federal Water Pollution Control Act Amendments of 1977 and the Resource Conservation and Recovery Act (RCRA) of 1976 may create new sets of problems for the technologies used to control sulfur dioxide emissions.

This brief review shows that the problems of coal combustion are various and formidable. Several post-combustion cleanup technologies are being introduced to mitigate these problems. If successful they will facilitate the continued direct use of coal as a primary source of electricity until improved and inexhaustible energy sources are available. Also, synthetic fuels and improved efficiency technologies, discussed later in this Chapter, can inherently avoid some of the emissions problems of direct combustion techniques.

Sulfur Oxide Controls -- Sulfur oxide emissions from direct coal combustion can be controlled in three general ways:

- at the front-end (before combustion), through use of low sulfur coal or cleaning of higher sulfur coal;
- at the back-end (after combustion) through the removal of sulfur oxides from the flue gas; and
- during specialized combustion processes (for instance, fluidized bed combustion), through chemical capture of sulfur oxides as as part of the combustion process.

Use of low sulfur coal or cleaning of higher sulfur coal are two common ways to meet current NSPS and SIPs, especially for older plants. They may not satisfy the standards for new plants required by the Clean Air Act Amendments of 1977. Use of lower sulfur coal, obtained with or without physical cleaning, is an attractive method to meet current emission standards because it costs less than back-end (post-combustion) controls. DOE is funding RD&D for pre-combustion coal cleaning at $10 million in FY 1979 and $14 million in FY 1980.

However, revised NSPS will require removal of a substantial part of the coal's original sulfur content. Without use of another control technology (such as flue gas desulfurization), most front-end clean-up will not meet the new standards. One method that will, however, is solid solvent refined coal (SRC-I), an ash-free, hydrogenated solid coal product that may meet the stricter standards for new plants without post-combustion control. On the other hand, some of the intermediate products of such technologies have been found to contain potentially carcinogenic and toxic substances. Although there is no regulation of these by-products presently, it is clear that worker and public health must be protected from such effluents. In recent years, the Government has supported RD&D on two processes for solvent refined coal -- one that produces a solid and the other a liquid. Funding for one commercial demonstration plant has been linked to an upcoming competition between the SRC solid and SRC liquid processes. Funding for a second commercial demonstration plant would now be provided from the Energy Security Fund.

Back-end control systems, particularly flue gas desulfurization (FGD), are now being used to meet sulfur oxide emission standards. However, their economics and reliability have not been demonstrated fully. New FGD systems to meet even more stringent standards are being developed. These improved FGD technologies, particularly regenerable systems, limit the volume of wastes collected and thus reduce many of the water pollution and waste disposal problems which face the "throw-away" processes.

The new "regenerable" systems are expected to be available in the 1980s. The sulfur emission control costs for existing and improved systems will range from about $.40 to $.70 per million Btus (compared with coal costs of $1.00 to $1.50 per million Btus). FGD is a critical control technology that requires high priority if coal is to realize its full market potential. The Energy Department's budget to improve FGD technology has been increased from $3 million in FY 1979 to $25 million in FY 1980.

Fluidized bed combustion (FBC) is another way to meet air pollution standards with high sulfur coals. The coal burns in a fluidized bed of coal and limestone. Sulfur dioxide is captured chemically by the limestone and discarded with the ash. Small industrial-scale FBC units are available now and the Department of Energy is encouraging demonstrations. Larger-scale utility systems require more technical development and initial commercial demonstrations. In the near term, industrial FBC systems should provide energy at about the same cost as conventional coal combustion with FGD. Aside from their environmental advantages, FBC systems could also become more economical and efficient once they have been fully demonstrated and are being built in commercial quantities. Development of fluidized bed combustion systems is funded at $41 million in FY 1979 and $48 million in FY 1980.

Because of the critical importance of environmental controls for direct coal use and the uncertain relative costs of all these approaches in the face of current and projected standards, the Government's strategy is to develop several major technology options on an accelerated basis. Total funding for these efforts jumped from $17 million in FY 1979 to $57 million in FY 1980.

Synthetic Liquids and Gases

The Government intends to demonstrate the capability to produce synthetic liquids and gas from coal by the mid 1980s so that significant capacity can be built when oil prices rise enough to make synthetics competitive. Technologies for making premium synthetic liquids and pipeline quality gas from coal can be modified to make lower cost industrial fuels. Industrial use of synthetic fuels will depend on the economic conditions in the industry and whether health and environmental problems associated with production and use of synthetics can be resolved. In fact, satisfactory development of all of these technologies depends on solving environmental and worker safety issues in parallel with economic and technical issues.

The Energy Department's synthetic fuel program includes a number of different research, pilot, and demonstration projects as well as participation in international R&D programs. The following activities are underway:

- Demonstrations of the manufacture of boiler fuels from coal to displace residual fuel oils and other products. Demonstration of a Solvent Refined Coal (SRC) process on a commercial-scale has high priority, and related processes are being pursued in the pilot plant phase.

- Limited investments in alternative ways to produce coal substitutes for lighter oil products--such as gasoline, distillate fuels, and methanol.
- Commercial-scale use of a conventional gasification process to convert noncaking Western coal to pipeline gas.
- Support of an advanced gasification process to demonstrate the ability to use a broader range of coals and to lower costs.
- Expanded RD&D to stimulate industrial uses of medium Btu gas, low Btu gas and synthesis gas from coal.
- Development of methods to reduce synthetic fuel costs by work on highly advanced ("third generation") processes.
- Research and development to define the environmental and safety effects associated with the production and use of coal-derived liquids and gases. These efforts will also develop appropriate control technologies and the operational environmental data on which to base future standards and regulations.

These activities span a wide range of processes and fuel products. But certain elements are common to many of the processes and specific applications. Virtually all of them involve gasification, either to convert raw coal into gas for further processing or to convert a residual char into hydrogen for subsequent use. For this reason, it should not be necessary to build separate pilot or demonstration plants for every possible combination of processes to make liquids or gases. Judicious selection of R&D projects, pilot plants, and commercial demonstrations can develop useful information on a wide spectrum of coal synthetic options.

As Table V-1 shows, the Administration continues to support a robust mix of programs for synthetic fuels. Due to stringent budget requirements the Administration had to be more selective when funding demonstration projects in FY 1980. However, creation of the Energy Security Fund will help support more projects to develop major technology options. For example, the Fund will make it unnecessary to choose between the SRC-I (solids) and the SRC-II (liquids); the Federal share for a second SRC plant would come out of the Fund.

TABLE V-1

FUNDING FOR COAL SYNTHETICS
(Million Dollars)

	FY 1979	FY 1980
Liquefaction	206.4	122.3
Pipeline (Hi-Btu) Gasification	67.0	85.0
Low- and Medium-Btu Gas	54.0	40.7
Advanced Research and Support	42.6	39.9
Total	366.0	291.7

The Fund could also make available loan guarantees for selected coal-synthetic projects which need Federal assistance to overcome market barriers. Although current Federal statutes give generic loan guarantee authority to the Department of Energy, they include a number of requirements that inhibit the issuance of the guarantees. The Administration will propose modifications of existing statutes to streamline procedures for making loan guarantees.

Improved Coal Use Efficiency

Many advanced coal technologies for the generation of electricity hold the promise for much higher efficiencies in the conversion from coal to electricity. These technologies also reduce pollution as an integral part of the process rather than in back-end clean up systems. There are several major technology options:

- Magnetohydrodynamics (MHD) uses advanced generation techniques and very high temperature coal combustion process to generate electricity at high efficiency for base load applications.
- Advanced fuel cells convert synthetic gas from coal to electricity in electrolytic cells--another option for base or intermediate load generation.[1/]

[1/] Fuel cells that use natural gas or petroleum-based naphtha as a fuel are becoming commercial now; but fuel cells that use coal-based fuels still require extensive development.

- Pressurized fluidized bed (PFB) combustion links fluidized bed combustion with advanced turbines and other heat recovery systems to achieve high efficiencies in the generation of electricity. This technology may be more effective in reducing emissions than atmospheric fluidized bed combustion.

- Improved turbines can attain higher operating temperatures and higher efficiencies, as well as handle heavier and dirtier fuels within environmental limitations.

Most of the advanced electric generating systems that emphasize fuel efficiency will play a longer term role in the Nation's energy strategy. One exception is a technology that combines coal gasification with a gas turbine and a steam cycle. With advanced high-temperature turbines, this "combined cycle" system can raise efficiency, lower generating costs, and reduce emissions in the long term. With conventional turbines, the system still has significant environmental advantages; and it may permit coal-fueled electric generation, though at higher cost, even in areas with severe environmental constraints. Accordingly, one California utility system and a consortium of Midwest utilities intend to demonstrate such a coal-fired combined cycle system.

The Administration will fund programs for the advanced conversion technologies at $184 million in FY 1979 and $142 million in FY 1980.[1]

Coal Supply and Production

Coal use will not increase if supplies are too costly. Movement toward replacement-cost pricing for oil and gas will make coal use much more attractive. But coal prices are not regulated, and some oil-import savings may not occur if those prices needlessly increase.

The Administration intends to discourage higher coal prices that do not reflect real increases in the cost of producing and delivering coal supplies. It will also support development of more cost-effective methods to mine and transport coal in an environmentally acceptable manner. Specific actions include the following:

1/ This accounting does not include funding for fluidized bed combustion.

- Timely leasing at fair market value of Federally-owned coal reserves in the West will help increase competition within the industry. This leasing program is intended not only to permit greater coal production on Federal lands, but also to assure that such production is consistent with comprehensive land use management principles.

- Federal R&D will seek to develop lower-cost, more efficient mining technology. The R&D program for underground and surface coal mining is funded at $66 million in FY 1979 and $46 million in FY 1980. The Energy Security Fund will support the accelerated development of mining systems that will increase both worker safety and labor productivity, as well as meet water and land reclamation regulations.

- The Department of Energy will intervene as necessary before the Interstate Commerce Commission to assure that railroad rates properly reflect the marginal cost of transporting coal.

- Coal slurry pipelines will improve the Nation's ability to use coal, and to deliver it economically from areas where it is mined to plants where it can be used. The Administration supports legislation to ensure that coal slurry pipelines can secure necessary rights of way. Under appropriate conditions, coal slurry pipelines can improve competition and offer a cheaper way to move coal. Each system approval requires a careful assessment of impacts on water availability, local ecology, and competing modes of transportation. The Administration will work with the Congress to develop an efficient review procedure to minimize the time required for these assessments and to assure prompt decisions.

The President has also directed the heads of the three Federal agencies having the major responsibilities for coal regulation--the Department of the Interior, the Department of Energy, and the Environmental Protection Agency--to report to him within 60 days concerning ways to increase coal production, development and use.

B. Nuclear Power

Although nuclear power has its origins in nuclear weapon research conducted during World War II, nuclear-generated electricity was not important in the civilian economy until the early 1960s. At that time, after government and industry had jointly funded and operated several demonstration plants, electric utilities began to place orders for large numbers of commercial nuclear reactors. The first of these began operation in the early 1970s. Orders for new nuclear plants exceeded orders for coal-fired plants through the late 1960s and early 1970s. From 1971 through 1978, utilities placed orders for 105 nuclear plants. By 1978, 38 of these orders had been cancelled. In all of 1978, only two new plants were ordered.

In part, this sharp decline reflects the downward revisions of electricity growth forecasts. Equally important, however, public concerns have increased over a series of unresolved questions about nuclear power--specifically, the management of nuclear wastes, the safety of reactor operations, health and environmental risks, and proliferation of nuclear weapons. Permitting delays arising from the public controversies over these critical issues coincided with a substantial decline in labor productivity. Some nuclear projects experienced large cost overruns and often required what some utility executives viewed as excessive management attention.

The recent accident at the Three Mile Island plant in Pennsylvania has reinforced safety and other public concerns. But as the U.S. regards its energy options after Three Mile Island, the role of nuclear power must receive a considered and objective assessment. The future of nuclear power will change--for the better, if safety and other issues are successfully resolved.

The U.S. now obtains 13 percent of its electricity from nuclear power. Any precipitate action to close a large number of reactors in operation now could seriously aggravate U.S. oil import dependence. In the long term, nuclear energy can help ensure a balanced energy supply system. In the absence of a nuclear power, alternative domestic energy supply sources (especially coal) would be harder pressed, and their costs pushed higher.

In the past, coal, oil, gas, uranium, and hydropower have competed with each other for shares of the electricity market. Regional factors determined the mix, and the price of electricity has been stable. In the future, however, coal is expected to replace large quantities of oil and gas in electricity and many industrial uses. Coal use is expected to double or triple by the end of the century and continue to grow at 3 percent a year thereafter. If nuclear power were not available, coal would have to supply most of the mid and long term electrical demand until new sources such as solar were developed. This would cause serious environmental, occupational safety, and social problems as well as the possiblity of a significant rise in coal prices.

STRATEGY FOR NUCLEAR POWER

First, the Administration seeks to re-establish the light water reactor (LWR) with the once-through fuel cycle as a viable supply option and thereby ensure that nuclear power will be a significant source of energy for the rest of this century. Second, it will continue the development of nuclear power as a potential backup technology for the next century. To implement this strategy, the Administration is pursuing two courses:

- To establish the safety of nuclear power and resolve other technical and institutional issues now impeding nuclear growth; and

- To develop new technologies that permit expanded use of nuclear resources.

Light Water Reactors--The Technical And Institutional Issues

To reestablish the light water reactor as a viable supply option, three issues must be resolved--reactor safety, nuclear waste management, and nuclear siting and licensing. Until reactor safety and waste management issues are resolved, utilities will hesitate to commit to new nuclear plants. Improved siting and licensing procedures are needed to ease the transition through this period of uncertainty by changing the requirements for planning additional plants. Other Federal programs are designed to improve uranium utilization so that existing uranium resources can fuel a larger number of light water reactors, using a once-through fuel cycle. This will extend the time available before breeder reactors need to be commercialized.

Reactor Safety--In response to the Three Mile Island accident, the President has established a fully independent Presidential Commission, including nuclear experts. The Commission will investigate:

- the circumstances that led to the accident and the events that followed;

- the technical questions that the accident raises about the operation of safety and back-up systems for this plant and plant design; and

- the nature and adequacy of the response to the accident by all levels of government.

The President has asked the Nuclear Regulatory Commission (NRC), an independent regulatory body, to accelerate its schedule for putting permanent resident NRC inspectors at every reactor site. Under a program started in 1978, the NRC now has permanent inspectors at 20 reactor sites covering 26 individual reactor units. The President has also instructed the Department of Energy to work closely with the NRC to determine what additional safety precautions may be necessary.

Nuclear Waste Management--Radioactive wastes are generated in a wide variety of activities--research, medicine, defense-related nuclear operations, and in the operation of commercial nuclear power reactors. Over the last decade, the public has become increasingly concerned over whether these wastes can be safely managed. This concern has been tied to the question of whether nuclear power generation should be allowed to expand.

Recognizing the urgent need to find an effective solution to the problem, the April 1977 National Energy Plan pledged to develop a national nuclear waste management policy and program. To acquire the views of pertinent Federal agencies and State and local interests, the President established an Interagency Review Group (IRG) and asked it to design a strategy for dealing with the waste management problem.

The primary objective of waste management planning and implementation is to assure that "existing and future nuclear waste from military and civilian activities (including spent fuel) should be isolated from the biosphere and pose no significant threat to public health and safety." The IRG developed the concept of an "interim strategic planning basis" to use during the interim, since the required environmental and safety studies had not yet been completed and final decisions could not be reached.

The IRG found the most urgent need was for a safe, permanent repository for high-level military and civilian wastes (including spent fuel). Such an effort will require detailed studies of repository sites in a wide variety of geologic environments and diverse media, using a systems approach. Pending completion of the decision process under the National Environmental Policy Act, the IRG has recommended the following actions from the interim planning:

- A number of potential sites in a variety of geologic environments should be identified and early action should be taken to resolve whether to use them at an appropriate time. A single national repository for wastes should be avoided. Near-term strategy should seek to have at least two (and possibly three) repositories in operation within this century; insofar as technical and other considerations permit, these repositories should be in different regions of the country. Under such a regional approach, the geologic, hydrologic, and other technical characteristics of the sites and safety considerations will constitute the primary basis for selection.

- Construction and operation of each repository should proceed in steps. Initial emplacement of waste, at least in the first repository, should be planned on a technically conservative basis. The wastes should be retrievable for some initial period of time. The manner and circumstances in which waste would be retrieved and the technical aspects of waste packaging, containment and handling must be further defined.

A second major waste management concern is the disposition of existing and future uranium mill trailings. In the case of existing sites that pose excessive health risks, the Department of Energy is developing programs to stabilize tailings at the site or remove them to other locations. In addition, new technologies to stabilize tailings are currently being developed to meet the most stringent criteria.

Away-from-reactor (AFR) storage of spent commercial reactor fuel is needed as a temporary bridge between storage of spent fuel at the reactor site and permanent repositories. Possible approaches include modification of an existing storage facility (either in Barnwell, South Carolina; Morris, Illinois; or West Valley, New York);[1] construction of a new facility within the U.S.; or construction of a new facility in a remote off-shore area.

The Administration takes the position that some AFR storage capacity is needed by 1983 for domestic spent fuel. Because of this deadline, use of some existing storage facility is preferred. Furthermore, the U.S. wishes to assure foreign users that the it will be able to receive limited amounts of foreign spent fuel to the extent this serves nonproliferation objectives. Environmental impact statements on AFR

1/ These existing storage facilities were built by industry as a part of commercial reprocessing plants. Since reprocessing is not permitted, these facilities are not being fully utilized by their industrial owners.

domestic fuel storage, foreign fuel storage and fee charges for such storage should be completed this year. In addition, an environmental impact statement on three potential ARF sites is now being prepared. The Administration has submitted legislation to Congress to implement this AFR program.

The Energy Department has funded waste management programs in the amounts shown on Table V-2.

TABLE V-2

FUNDING FOR NUCLEAR WASTE MANAGEMENT
(Million of Dollars)

	FY 1979	FY 1980
Commercial	191	199
Defense	257	372
Spent Fuel Disposal	11	21
Away from Reactor Storage	0	300[1]
Total	459	892

Nuclear Siting and Licensing Legislation--Last year the Administration proposed legislation to reduce the uncertainties in the nuclear power plant siting and licensing process and to shorten the 10 to 12 year period it now takes to plan, design and build a plant. The Administration will continue to work with Congress to reduce unnecessary and duplicative steps in the siting and licensing process without compromising safety.

The key provisions of the bill included early site selection, environmental and safety review, and "banking" of a site before construction permits are filed for. It also provided for early approval of standardized plant designs independent of the site selection process and combining the application for a construction permit and an operating license. The bill transferred much of the responsibility to the States and called for more public involvement in the decisionmaking process.

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[1] Special authorization request accompanying proposed legislation for away from reactor storage facilities.

It is essential that questions about safety and environmental protection and the timeliness with which the process is carried out be reviewed thoroughly and necessary changes made. The Administration expects to work with the Congress to find the appropriate next steps to improve the siting and licensing process to assure both greater safety and efficiency. The Secretary of Energy will submit nuclear siting and licensing legislation to Congress.

Uranium Resources and Their Use

Concern over whether the U.S. uranium resource base is adequate has led to pressures to accelerate the breeder program and to commit to reprocessing. Because of the large uncertainties in present knowledge, a systematic appraisal of domestic uranium resources is being conducted through the National Uranium Resource Evaluation Program (NURE). It is designed to lay an adequate foundation for future fuel cycle decisions and domestic and foreign utility planning.

To recover the maximum energy from the domestic resource base, the Department of Energy has developed programs to:

- Stimulate private industry R&D to improve light water reactor operating efficiency.
- Construct an energy efficient gas centrifuge enrichment plant designed to produce 8.8 million "separative work units" (SWU). The first 2.2 million SWU are now planned to be in operation around 1988. Additional 1.1 million SWU modules can be added up to design capacity as demand grows. The added capacity permits operation of the enrichment enterprise in a way that conserves uranium resources by recovering a greater portion of the fissile uranium isotope.
- Develop advanced isotope separation technology (AIST). This technology, if successfully developed, would permit economic production of nuclear fuel from depleted uranium "tails," thereby increasing by about 20 percent the enriched uranium recoverable from known reserves.
- Examine advanced converter reactor concepts in cooperation with foreign developers as an alternative way to increase uranium conversion efficiency.

The Department's funding for these activities is summarized in Table V-3.

TABLE V-3

FUNDING FOR IMPROVED URANIUM UTILIZATON (Million Dollars)

	FY 1979	FY 1980
National Uranium Rescurce Evaluation (NURE)	69	84
Light Water Reactor Efficiency	24	25
Gas Centrifuge Operations & Support (including construction)	241	409
Advanced Isotope Separation	54	55
Advanced Converter Program (Gas Cooled Thermal Reactors)	42	12
Total	430	585
Revenues from Enrichment Operations Excluding Centrifuge Plant but Including Sales of Enrichment Services.	-262	-493

New Technologies

In the long term, the U.S. will rely increasingly on renewable or essentially inexhaustible sources of energy. The breeder reactor is one long-term energy option because it has the capability to produce more fissile ("burnable") fuel than it consumes. The breeder reactor would not only sustain itself, but would also generate fuel for light water reactors.

Interest in the breeder reactor grew out of a desire for an option that would not disappear with the inevitable exhaustion of natural fissile uranium. The interest intensified when early estimates promised even lower cost electricity from the breeder than from the light water reactors, and resulted in programs for early commercialization.

This Administration, however, believes that rapid steps toward breeder commercialization are not needed now. The timing of the breeder program depends on the economic need for the technology and on nonproliferation issues. It is also linked to resolution of the reactor safety and waste management problems affecting the whole nuclear option. The leading breeder candidate (liquid metal fast breeder), if commercialized, would necessarily lead to reprocessing and to widespread use of plutonium. The President, in the context of his nonproliferation policy, directed deferral of such activities and cancellation of the Clinch River Breeder Reactor project while alternative fuel cycles are examined.

While preliminary results of the International Nuclear Fuel Cycle Evaluation (INFCE) do not suggest the likelihood of risk-proof breeder alternatives, improvements over current and proposed practices are being developed. The INFCE is considering various technical approaches to improving the proliferation resistance of breeder and converter reactor fuel cycles. It is also studying the appropriate timing for their development and commercial use.

Over the past decade, economic arguments have been used to justify the pace of the breeder program. Such justifications hinge on a few key factors--the overall demand for electricity, the uranium resource base, reactor efficiency, and the relative capital costs of light water reactors and breeders. If the demand for electricity grows rapidly, if domestic uranium resources are limited, and if breeders cost little more than light water reactors, then rapid commercialization would be economically attractive. Such perceptions prevailed in the late 1960s and early 1970s when electricity generation, particularly nuclear electricity, was growing rapidly.

Since the 1973-74 oil embargo, several circumstances have changed. Projections of electricity growth rates have dropped from 7 percent a year to around 3 to 4 percent for the long term. Light water reactor growth has slowed because of the problems noted earlier, indicating that uranium resources will last longer. Finally, early optimistic estimates of breeder reactor capital costs ranging from 0.9 to 1.3 times those of light water reactors have been replaced by estimates of 1.25 to 1.75.

These changed factors have been reflected in a recent analysis of the pace of breeder development. Typical of this analysis is the case summarized in Figure V-2. Nuclear electricity demand is described by the amount of installed nuclear capacity in 2000 and in 2020; uranium resources are described in terms of price; and breeder capital costs are described in relation to LWR capital costs. Figure V-2 shows that with reasonably attainable improvements in current LWR fuel efficiency, breeders would not be needed until after 2020 in most cases. The exceptions are when uranium costs are high, nuclear demand is high, and

Figure V-2
Timing of the Need for a Fast Breeder Reactor in the Long Term[1]

Fast Breeder Reactor Capital Cost[2]	U_3O_8 Price	Installed Nuclear Capacity (Gigawatts Electric)									
		200			300			400			← Year 2000
		400	500	600	500	600	700	600	700	800	← Year 2020
1.75	Intermediate	☐	☐	☐	☐	☐	☐	☐	☐	☐	
	High	☐	☐	☐	☐	☐	☐	☐	☐	☐	
1.50	Intermediate	☐	☐	☐	☐	☐	☐	☐	☐	☐	
	High	☐	☐	☐	☐	☐	▨	▨	▨	▨	
1.25	Intermediate	☐	☐	☐	☐	☐	☐	☐	▨	▨	
	High	▨	▨	▨	▨	▥	▥	▥	▥	▥	

▥ 2000-2010
▨ 2010-2020
☐ After 2020

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[1] Assumes 15 percent improvement in U_3O_8 utilization over current practice in a once-through cycle.
[2] Relative to the capital cost of a light water converter reactor.

breeder capital costs are low. Only under the most extreme cases would the breeder be economically justified in the 2000-2010 period. Successful development of advanced isotope separation technologies would ease the pressure for an early breeder even further. In such a case, the need for an early breeder occurs only for 400 GWe on line in 2000, for breeder capital costs of 1.25 times those light water reactor, and for high uranium prices.

In light of this economic analysis, the four possible RD&D program strategies will be considered below:

- Late Breeder. This strategy assumes that the resource base is adequate for a long period of once-through light water reactor operations, that the nuclear growth rate will be low, or that breeder economics will be unfavorable. Consequently, breeder development would be pursued at a low level and commercialization of the breeder would be deferred as long as possible. A decision on a demonstration plant would be deferred until the 1990s, as would be reprocessing development. Light water reactor improvements, advanced converter reactor development, advanced isotope separation, uranium resource evaluation, and centrifuge facility deployment and development would be emphasized.

- Hedged Breeder. This strategy assumes that the resource base, nuclear growth, and breeder economics do not require rapid commercialization of the breeder. However, because of uncertainty, the strategy would maintain sufficient flexibility and options so that program shifts could be made easily and effectively whenever information or events dictate. The programs for light water reactors, advanced converter reactors, advanced isotope separation, uranium resource evaluation, and centrifuge facilities would be emphasized, but less strongly than in the late breeder.

  Breeder development would continue at a moderate level with emphasis on engineering and component development. A decision on a demonstration plant could be taken in 1981, but also could be deferred until 1986-1990. Plans for both a 20-year and a 30-year commercialization program could be developed. Reprocessing technology would be developed, but commercialization deferred. This program attempts to minimize risk at a moderate cost.

- Early Breeder. This strategy assumes that the uranium ore base is limited, that the nuclear growth rate will be high, and/or that breeder economics will be very favorable. It implies an early commitment to the breeder, with completion of a conceptual design study by 1981, commitment to a demonstration facility by 1982, and initial commercial deployment 20 years thereafter. Reprocessing development would be given high priority through commercialization. Programs for light water reactor improvement, advanced converter reactor development, advanced isotope separation, and uranium resource evaluation would be de-emphasized. This strategy would require a relatively high cost, high risk program.

- Expanded Nuclear. This strategy assumes that nuclear power will play a predominant role in our energy future, with installed capacities at least equal to the highest values assumed in the analysis. Aggressive programs would be indicated for light water reactors, advanced converters, and breeders--with commitments to commercialize them at the earliest possible dates. For the breeder, this would call for a demonstration plant decision in 1981 and planning for both a 20-year and a 30-year deployment schedule. Reprocessing, through the commercialization stage, would be accelerated. The program would be very costly but would provide the greatest assurance of maintaining and deploying the nuclear option.

The Administration favors the hedged strategy. The breeder program itself includes the liquid metal fast breeder (LMFBR) as the primary option, but would also support two others--the light water breeder reactor (LWBR) and the gas cooled fast reactor (GCFR). Each has particular strengths and weaknesses and provides a hedge against failure of one particular approach.

The Administration's decision not to build the Clinch River Breeder Reactor, a large LMFBR demonstration plant, needs to be viewed in light of the analysis that has taken place over the past decade. Furthermore, for a variety of technical and economic reasons, the Clinch River Plant is no longer considered to be adequate in size or design for a commercial demonstration. Those elements of the Clinch River project which can be used intelligently will be completed. The systems design will be completed together with certain components which have value for test purposes.

In place of the Clinch River plant, the Administration proposes substitution of a conceptual design study as the central focus of the LMFBR program. The results of this study together with recommendations regarding the future course of this program will be presented to the Congress in March 1981.

C. Policy for Coal and Nuclear Power

The Nation's mid-term energy situation depends on successfully maintaining and expanding the use of coal and nuclear power. These two sources are commercially available today and can be enlarged if the markets grow and their critical environmental and social problems are overcome.

The markets for coal and nuclear power are closely tied to the growth in demand for electricity, although coal can also be used in large industrial facilities. The Fuel Use Act gives the Department of Energy the regulatory tools to stimulate the use of coal and nuclear energy resources.

The primary constraints on this movement away from oil and gas arise from the regulatory and technical problems surrounding coal and nuclear power. Development of methods to use coal more efficiently, convert coal into clean fuels, and improve breeder reactors will be important for the long term as coal and conventional uranium fuels are exhausted. It will be different to make this long-term transition, however, without increased use of direct coal burning and light water reactors. Efforts to develop long-term options must be balanced with programs to assure that direct use of coal and nuclear power will be available in the mid term, consistent with public safety and maximum environmental protection.

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CHAPTER VI

SOLAR AND OTHER INEXHAUSTIBLE ENERGY RESOURCES

The modern world's economic and industrial growth has, to a large extent, been based on extensive use of fossil fuels. Within a few decades, however, these resources are not likely to be available in sufficient quantities to sustain increased levels of world energy consumption and continued growth. Eventually, even the transitional energy sources described in Chapters IV and V will be depleted beyond economic recovery. Significant new supplies of inexhaustible energy will be required to meet the world's energy needs.

Government clearly has an important responsibility in developing these new energy supplies and guiding the transition to their eventual use. Research, development and planning that are undertaken today can create a variety of technology options for the next century. In most cases, the decision to deploy these technologies will be left to future generations, but government can help to ensure that this transition occurs with the least disruption and cost.

Furthermore, use of reasonable quantities of inexhaustible energy, especially solar, seems highly desirable before the end of this century. Accelerated solar energy development can reduce the risks of extremely rapid oil price rises, and provide insurance against unusual constraints on domestic energy supplies like coal or nuclear power.

Currently, the Department of Energy is pursuing four major long-term energy options--solar, geothermal, fusion, and breeder reactors[1/]. Each technology differs in the markets it can serve and in the problems it faces. Because of technical, economic, environmental, and institutional uncertainties, it is neither feasible nor desirable at this time to exclude any of these options.

The Administration's strategy for long-term energy options is to gain extensive experience and information concerning these techologies so that choices made later will be better informed. The timing of these decisions depends on the extent to which energy conservation goals are realized and additional conventional resources are developed. The quality of information about solar and other inexhaustible technologies depends on the success of R&D, efforts to meet cost and performance goals, public awareness and acceptance, and government policies at many levels.

1/ The Department's breeder strategy is developed in the context of the overall nuclear strategy and is presented in Chapter V.

While fusion and the breeder can have an impact only in the long-term and only in the electricty sector, solar and geothermal can have a wide range of uses in the near- and mid-term. Passive solar heating, solar hot water, some forms of active solar heating, hydroelectric power, direct burning of wood and agricultural residues, and geothermal direct heat and electricity are in commercial use today. An aggressive and expanded effort could heighten the immediate benefits from these resources significantly. Also, solar energy can be used in both centralized and decentralized applications. Finally, the Nation's experience in applying these sources in a limited way now can help lay the industrial and institutional groundwork for more substantial long-term contributions.

A. Solar Energy[1]

In the early 1970s, new interest emerged in a wide range of solar technologies as public concern grew over rising energy costs and the environmental problems associated with conventional fuels. Recently, the role that solar energy should play in meeting the Nation's energy objectives has become the focus of much public debate. At one end of the spectrum, some view solar energy as an exotic and expensive option, outside the mainstream of energy development and incapable of more than a small contribution to energy supply. At the opposite end, solar energy is viewed as a major and immediate source of vast new energy supplies, offering an opportunity to move away from centralized energy systems and create an environmentally benign supply system.

At the request of the President in the spring of 1978, the Department of Energy and other Federal agencies undertook a Domestic Policy Review (DPR) of solar energy. The DPR, now completed, has reviewed current Federal solar programs and assessed whether they represent the best strategy for accelerating commercial solar use. The DPR also attempted to evaluate the costs and benefits of accelerated deployment of solar technologies and estimate the contribution that the Nation could expect from solar energy by the end of the century.

Since one cannot "predict" future solar energy use with any more certainty than future world oil prices, the DPR developed several projections of solar energy use based on alternative levels of government effort. A starting point for these projections was the fact that solar energy now contribute about 4.8 quads annually, or 6 percent of U.S. energy supply (mainly in the form of hydroelectricity and biomass).

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[1] Solar energy is defined broadly to include the energy received from the sun directly in the form of radiant energy and indirectly in the form of biomass (wood, vegetation, and organic solid wastes), wind, hydropower and temperature differences in the ocean.

In the DPR "base case," in which present policies and programs continue, it is estimated that solar energy could displace about 10 quads of conventional fuels in the year 2000. This is consistent with more recent NEP-II projections. This "base case" estimate assumes the increased use of solar energy use stimulated by the solar tax credits in the NEA. It does not include, however, the additional use of solar energy in 2000 likely to result from the new solar tax credits announced in the President's April 5 energy message.

The "maximum practical" case assumes more aggressive government actions to push solar--but actions that would still work mainly through markets and allow consumer freedom of choice. In this case, total solar use in 2000 could be nearly twice as high as in the base case--roughly 18 quads, or somewhat less than 20 percent of the Nation's total energy use.

Finally, in the "technical limits" case, the Federal government would not rely primarily on market mechanisms or consumer choices to expand solar use. Instead, the Federal government would play a much more active role in the design of residences and commercial buildings, in industrial decision-making and in energy planning generally. This future measures the technical limits on expanded solar use imposed by changeover in the existing stocks of capital and buildings and the speed with which solar technologies can be manufactured and deployed. In such a future, solar energy use could increase by another 10 quads, displacing 28 quads of conventional fuels.

Table VI-1 shows the total quads displaced by solar in the year 2000 in each of these cases, as well as the estimated contributions of the various solar technologies. It is important to note that the Table shows the amount of conventional energy displaced, not the amount actually supplied to end-users. This energy displaced includes the energy lost in conversion and distribution, as well as the useful energy that would have been required to meet the end-use demand now served by conventional fuels. In general, solar energy--which lends itself more readily to dispersed applications results in fewer distribution and conversion losses than conventional energy systems.

Table VI-1 suggests that solar energy can play an important role in the Nation's energy supply by the turn of the century. The Solar DPR attempted to survey the benefits and costs that would be incurred by an accelerated government effort to realize this potential. It reviewed the many available solar technologies on a market-by-market

TABLE VI-1

POTENTIAL CONTRIBUTION OF SOLAR TECHNOLOGIES IN 2000[1/]

(quads per year)

Market	1977	Year 2000 Cases Base	 Maximum Practical	 Technical Limit
Residential/commercial sector				
Active systems (hot water heating, space heating, and space cooling)	Small	0.9	2.0	3.8
Passive systems	Small	0.2	1.0	1.7
Industrial/agricultural sector[2/]	-	1.0	2.6	3.5
Electricity generation				
Hydro				
High head	2.4[3/]	3.5	3.5	3.5
Low Head	Small	0.4	0.8	1.0
Solar thermal	-	0.1	0.4	1.5
Wind	-	0.6	1.7	3.0
Photovoltaics	-	0.1	1.0	2.5
Ocean thermal energy conversion	-	-	0.1	1.0
Solar power satellite	-	-	-	-
Biomass	1.8	3.1	5.4	7.0
Total Energy Displaced	4.2[3/]	9.9	18.5	28.5

(- = zero or negligible)

1/ The amount of conventional energy that can be displaced by solar energy, not the amount of energy actually delivered by solar systems. Single points are included for simplicity although the Domestic Policy Review estimated ranges.

2/ Includes process heat, on-site electricity and heating, and hot water.

3/ The energy displaced by existing dams during years of normal rainfall is 3.0 quads, which corresponds to a total current solar contribution of about 4.8 quads.

and region-by-region basis. The range of the study covers solar technologies at or near economic competitiveness, technologies could become economic in the mid-term, and technologies that have mainly long-term potential.

The DPR concluded that solar energy offers important advantages over many competing conventional technologies. In comparison to conventional fuels, solar energy is relatively clean and pollution-free.

Accelerated solar energy development also adds diversity and flexibility to the nation's energy supply, and provides insurance against rapid world oil price increases and major bradkdowns of conventional energy supply systems. As chapter I indicated, world oil prices could increase sharply over the next two decades. If solar technologies do not develop at a relatively rapid pace, they will not be available to substitute for more expensive fuels and reduce upward pressure on world oil prices. In addition, widespread availability of solar energy could limit economic disruption if conventional energy systems such as coal or nuclear power fail to acnieve current expectations. Projections in Chapter II showed increase solar use if there are major constraints on coal, nuclear power, or both.

Finally, solar energy could be critical for less developed countries that cannot afford expensive conventional energy systems. The U.S. can demonstrate international leadership in assisting developing countries with solar applications, as well as advance other important international goals.

SOLAR ENERGY STRATEGY

The solar energy strategy must recognize that widespread use of solar energy is hindered by subsidies to competing fuels, limited public awareness and confidence in solar energy, financial barriers faced by users, various Federal and State policies, and other economic and institutional barriers. The strategy must aim to remove these barriers, identify the full social costs and benefits associated with use of solar and conventional systems, and give R&D support to a broad spectrum of solar technologies.

The strategy has four different areas of emphasis:

First, the U.S. would accelerate commercial use in the near-term of those technologies that are economically competitive or nearly so.

These technologies include passive solar, solar hot-water heating systems, some forms of active solar space heat, low-head hydro dams and direct burning of biomass (e.g., wood-burning stoves). Tax credits and other financial incentives, as well as removal of the barriers described above, would build a solid foundation for greater solar energy use in the near-term.

Second, the U.S. should push the development of technologies that have commercial potential in the mid-term, but are not yet fully competitive in the marketplace. R&D, operational testing, Federal purchases and product support can lower the costs of some active solar space heating systems, wind, energy conversion systems and systems for conversion of biomass and agricultural products to liquid fuels and gases.

Third, the U.S. should develop technologies with great potential in the long-term, but which are much farther from economic application than the technologies described above. These technologies include solar cooling, some forms of agricultural process heat, biomass plantations, solar thermal power systems, and ocean thermal energy conversion (OTEC) systems. Extensive R&D programs and somewhat more limited Federal purchase and product support would be appropriate for these technologies.

Fourth, the U.S. should identify and evaluate longe-range solar options for which adequate information is not now available. These options include solar satellite power, photochemical conversion and other advanced concepts that require extensive basic and applied research.

The Administration's strategy for solar energy is still under careful review. Presidential decisions on the DPR are anticipated in the near future.

Problems and Barriers to Solar Energy Use

The DPR made clear that acceleration of solar energy use requires a wide variety of policy initiatives aimed at the specific problems and barriers that face particular technologies in particular markets. For example, the same technology may be economic in one type of market, but need further develoment before it is ready for another market. Many of the problems hindering solar energy use, however, stem from the basic fact that consumers do not appreciate the true comparative costs of solar systems and conventional systems.

First, market prices of oil, gas and electricity have often failed to reflect their true replacement or environmental costs. Nor do solar energy system costs reflect the national security advantages from reduction of dependence on foreign oil.

Table VI-2 compares the national average user prices of oil, gas and electricity with their replacement costs in 1977. The comparison shows the extent to which solar technologies have been at a competitive disadvantage because conventional fuels were underpriced. The oil and gas pricing policies in the NEA and the President's program--and the solar tax credits contained in both--should diminish these market imperfections.

Second, although solar energy can be cost-effective on a lifecycle cost basis, it often requires large initial capital investments. Where solar systems are financed, consumers may find that financing costs exceed initial energy savings. Savings are realized in later years as the fuel costs of conventional systems increase and as solar equipment costs are amortized.

Finally, a number of institutional barriers at the Federal, State and local levels can affect the choices between solar and conventional systems. Public utilities have the ability, through their rates, to encourage, discourage or be neutral to solar energy. Local building codes may hinder increased solar energy use. Local builders may not have enough incentive to take the risks associated with construction and sale of passive solar buildings. Federal regulatory and other programs have frequently failed to consider the means by which use of solar energy systems can help to meet program objectives.

Solar Energy Use in Specific Markets

The following sections discuss the potential for solar energy in various end-use markets and applications--heating and cooling of buildings, industrial and agricultural process heat, electricity generation, and the broad range of uses of biomass fuels.

Heating and Cooling of Buildings--Two of the most promising residential uses of solar energy are solar hot-water heating and solar space heating. Solar domestic hot water systems can compete economically against electric resistance heating in most regions of the country now. In the near future, it will be competitive in some regions with systems using other fuels. Specific differences in delivered costs, of course, vary by region, and local factors can affect the comparisons.

A wide range of solar technologies might be used in the home heating market. Many passive solar systems are economic today, but inertia and inadequate information dissemination to builders and consumers has slowed their use. Active solar heating systems deliver energy at costs that range from being nearly competitive with some fuels to several times greater. At present, solar heating systems are most

TABLE VI-2
1977 AVERAGE USER PRICES FOR CONVENTIONAL ENERGY SOURCES AND COSTS OF REPLACEMENT
(1978 dollars per million Btu)

Source	Average Price	Replacement Cost
Natural Gas[1/]		
Residential	2.50	2.70
Commercial	2.20	2.70
Industrial	1.80	2.70
Utility	1.75	2.70
Electricity[2/]		
Residential	12.80	14.90
Commercial	12.90	14.90
Petroleum Products[3/]		
National average	2.20	2.70

1/ Replacement costs represent the delivered price of industrial distillate.

2/ Replacement costs represent in-service costs for a new baseload coal-fired power plant, including scrubbers. This cost includes all transmission costs and 25 percent of distribution costs (since a portion of potential solar users will already be hooked up for lighting and other uses of electricity.)

3/ Replacement costs represent the average landed price of imports in 1977 (1978 dollars), converted into mmBtu at 5.8 mmBtu/bbl. Average prices represent refinery acquisition costs.

competitve with electric resistance heating. Improved installation, increased contractor experience, the development of lighter weight and more efficient solar units, and the use of hybrid systems such as solar-assisted heat pumps, could cut costs substantially in the future, while oil and natural gas prices are likely to continue rising. Solar cooling awaits more extensive R&D to reach the lower cost levels necessary for widespread use.

The Administration is seeking to commercialize solar heating and cooling technologies more rapidly with the solar tax credits in the NEA and with market development activities. Since the NEA tax credits were largely applicable to "active" solar systems purchased by consumers, the President has proposed a new tax credit available to builders who use passive solar designs in new construction. This credit would be available for construction in both residential and commercial markets.

The Administration also is seeking to identify and overcome a variety of barriers to residential solar use, and in the past has sponsored numerous demonstrations of heating technologies. Demonstrations of hot water and heating and cooling systems have been conducted in over 12,000 residential units and 250 commercial buildings during the past few years.

Industrial and Agricultural Process Heat--Industrial process heat markets cover several temperature ranges. In most of these markets, process heat from solar systems currently available to industry is two to three times more expensive than oil-fired heat. But costs of solar process heat systems are expected to decline in the 1980s as a result of technological improvements and mass production. At the same time, prices for oil and gas, which now supply now about 70 percent of industry's energy, could increase sharply, making solar even more attractive in this sector.

In the agricultural sector, solar energy must compete with oil, gas and propane. It is difficult to generalize about the comparative economics of solar and conventional fuels in this sector. The delivered energy costs from solar systems tend to be higher than those of conventional fuels in those agricultural systems where solar use is seasonal and the capital-intensive solar system is idle much of the year. On the other hand, the costs of oil and gas are greater for farmers than for most industrial users. Some forms of solar crop-drying systems have been in use for several years, and solar has great potential in the agricultural sector.

The existing credits for industrial and agricultural use of solar energy are too small and expire too soon to result in widespread use of solar technologies. To spur expanded use of solar process heat equipment, the President has proposed an additional tax credit for such equipment. The additional incentive provided by the credit will stimulate technological improvements and mass production sooner than would otherwise be expected.

The Administration's program to encourage use of solar process heat systems also embraces a variety of RD&D activities. About 50 agricultural projects and several industrial projects have been funded. Improvements in solar thermal electric power systems can also help develop better process heat systems for use in agriculture and industry.

Solar Electricity

Various solar energy technologies have the potential to generate electricity. Most of them, however--except for hydroelectricity and biomass (i.e., wood) fired electric generation--require significant further development before they can be considered ready for significant market use. The Administration is supporting a broad R&D program to improve understanding about solar electricity and its possible applications.

The economics of most solar electric technologies are still unclear. All of them except ocean thermal energy conversion (OTEC), would generate electricity only intermittently -- when the sun shines or the wind blows -- rather than in response to system demand. Since solar technologies generally have low operating but high capital costs, it would make sense to operate solar electric systems whenever possible. However, such intermittent operation requires careful integration of technologies into electrical delivery systems.

A number of solar energy systems currently generate, or have the potential to generate, large amounts of electricity. The following discussion briefly describes these solar electric systems and their present technological and economic status.

Conventional high-head hydroelectricity continues to be an attractive source of commercial electric power if favorable sites can be developed and environmental objections related to large impoundments resolved. High-head hydro is one of the most clean, dependable and efficient sources of energy the Nation has. Unfortunately, most of the available sites have already been developed.

Low-head hydroelectric generators can be installed at both existing and new dams to provide economical power in an environmentally safe manner. New England alone has hundreds of dam sites that can generate electric power. The Department of Energy is providing funds for feasibility studies for small scale hydroelectric projects. Under existing programs, other Federal agencies will provide grants, loans, and loan guarantees to accelerate these projects. Funds for this purpose may also be drawn from the Energy Security Trust Fund.

Combustion of wood and other biomass can compete economically with conventional fuels to generate base load electricity in special applications, if the biomass fuel is easily harvested and transported. Environmental emissions must also be appropriately considered and controlled. Under favorable economic and technical conditions, industrial cogeneration systems that burn wood, solid waste, or other refuse to make electricity and process heat simultaneously can also compete favorably with new conventional power plants. If biomass plantations become major fuel sources, water pollutants and erosion in cut areas will require special management.

Electricity from large wind machines (1 Mwe capacity or greater) is now several times more expensive than the average price of electricity from utility grids. With improved design and mass production, resulting in part from Federal R&D and purchases of wind machines, these costs are expected to drop by a factor of three by 1990. Several large machines are now being constructed; smaller machines are commercially available today and can compete in special markets where somewhat higher costs are justified.

Solar thermal power systems concentrate heat from the sun and convert it into electricity in conventional steam turbines or advanced cycle engines. They are still in the R&D stage and their costs must drop sharply to become competitive. It is still uncertain whether the costs of the heliostats, boilers, and other large components can be reduced enough by the Federal R&D and demonstration programs to meet overall economic targets, although significant progress is being made. Safety issues from misdirected concentrated light must also be addressed. Progress in this technology would also help develop high-temperature process heat equipment for industrial use.

Solar photovoltaic systems which convert sunlight directly into electricity, are available now in special high-cost applications. Photovoltaic systems consist of photovoltaic cells in the form of arrays and other system components which support the array, convert the dc output into grid-compatible ac power, and store excess electricity. A principal issue is whether photovoltaic array costs can be scaled down from their current levels of $10 per peak watt to $.10 to $.50 per peak watt, and whether total system costs can be reduced from about $20 per peak watt to $.70 per peak watt. At the lower end of this range, photovoltaic systems would be competitive with other utility alternatives. At the higher end, they could find markets in dispersed (e.g., residential) applications. They already are competitive with conventional alternatives in some foreign nations that lack electric power grids. Federal research efforts aim primarily to develop new concepts that can reduce costs.

Ocean Thermal Energy Conversion (OTEC) is being developed for base load applications in certain coastal and island sites where thermal gradients in the ocean can be used to generate electricity. If Federal RD&D efforts are successful, it may be used first in the 1990s in Hawaii and Puerto Rico, where it could compete with high-cost oil. OTEC systems may also be used in deep ocean sites to produce energy intensive products (e.g., ammonia) which can then be shipped to the mainland. Considerable R&D and field testing will be required to evaluate OTEC's true potential.

Satellite power systems and other advanced concepts are still the subject of research and feasibility studies, and cannot yet be considered viable options.

Biomass Fuels

Biomass energy systems embrace a wide range of technologies and products. Such systems include direct burning of wood as well as advanced photosynthetic conversion of sunlight into fuel.

- o Direct burning of wood and wood residues has been economic in the private sector for some time and already supplies 1.8 quads of energy annually, mainly in the lumber industry in decentralized uses. Major new uses will require technological improvement in collecting and transporting the raw materials. Efforts will also focus on controlling emissions from increased biomass combustion, especially in small residential units where control technology is not usually available. The President has proposed to extend the conservation tax credit in the NEA to include high-efficiency wood stoves to accelerate their use in residential heating. This credit would be funded from the Energy Security Fund.

- o Gas from conversion of animal wastes, wood, and agricultural residues is now marginally competitive, and is likely to become more so as the current technologies improve.

- o Methanol and ethanol from biomass are becoming increasingly competitive with alcohols from oil and natural gas as the prices for petrochemical feedstocks rise. There is now a surplus of methanol (made from natural gas), but many expect worldwide demand for methanol to grow, especially in high-value uses such as chemical feedstocks. Ethanol from biomass is expected to remain relatively expensive. However, if processes are improved as expected, the costs and amount of energy needed to produce ethanol should be reduced. Such a development would allay concerns about the relatively large amounts of energy required to produce ethanol.

- Gasohol, a mixture of biomass ethanol and gasoline, is now being marketed as an unleaded premium gasoline, primarily in the Midwest. This market may grow rapidly as the motor fuel tax incentives recently enacted by several midwestern States and the Federal Government take effect. Under the NEA, the 4 cent per gallon Federal excise tax on motor fuels for on-road use is eliminated for mixtures containing 10 percent or greater biomass alcohol, generating a subsidy equivalent to 40 cents per gallon of ethanol. This tax relief, scheduled to end in 1984, will be made permanent under the President's proposal to fund it from the Energy Security Trust Fund.

- Urban wastes contain large quantities of biomass that can be either burned or converted to premium fuels. Technologies for converting these wastes are commercially available, but marginal economics and institutional barriers are slowing their progress. Improved technology, higher costs for conventional solid waste disposal, and efforts to break down institutional barriers could make this technology both a source of energy and an efficient way to deal with solid waste.

- Basic research in photosynthesis is laying the scientific groundwork for biomass conversion systems that may ultimately convert sunlight directly into fuels. The work is still in its infancy, but progress is visible.

Solar Programs in the Federal Budget

Table VI-3 shows the Department of Energy's budgets in FY's 1979 and 1980 for the various categories of solar technologies. When the estimated revenue losses from the NEA solar tax credits and expenditures of other Federal agencies are added to this total the Federal solar program budget in FY 1980 will surpass $845 million, up from $720 million in FY 1979. Those technologies in category I of Table VI-3 will receive only limited RD&D funding, but will benefit from the NEA tax credits for residential and business investments in solar equipment. Programs for technologies that are now far from economic application will rely entirely on RD&D.

The combination of Federal R&D programs and solar tax credits provides a broad foundation for development of solar energy. Further Presidential decisions on solar energy will be announced soon. Solar technologies can clearly make important and growing contributions to the Nation's energy supply before the year 2000. Much greater contributions can be expected in the 21st Century. Such expanded use of solar energy will yield increasing environmental and other social benefits.

Table VI-3
DOE Funding for Solar Energy
(Million Dollars)

Strategy and Technology		FY 79	FY 80
I. For technologies that are economically competitive or nearly competitive.			
Solar Heating (Passive and Active)		18	35
Solar Hot Water		19	21
Biomass-Direct Burning		13	11
Low Head Hydro		28	18
Industrial Process Heat		17 1/	33 1/
	Subtotal	95	118
II. For technologies with significant potential but not yet ready for mass market.			
Solar Heating (Active)		51	27
Wind		62	68
Biomass-Conversion		23	40
	Subtotal	136	135
III. For technologies with significant potential for the long-term but now far from economic application.			
Solar Cooling		31 1/	31 1/
Agricultural Heat			
Biomass-Plantations		7	9
Photovoltaics		119	131
Solar Thermal		100	121
Ocean Systems		38	35
	Subtotal	295	327
IV. For long-term options.			
Satellite Power Systems		5	8
Multi-technology		37	69
		42	77
	Total	568	657

1/ Total for Industrial Process Heat and Agricultural Heat included under Industrial as an allocation between the programs is not available.

B. Geothermal

Geothermal energy--the heat stored in the earth--can be recovered by technology now available or under development. In numerous places in the U.S. and abroad, this resource has served special needs for a number of years. The largest application in the U.S. is the vapor-dominated (steam) resource at The Geysers in California. This resource was initially used in the 1960s and now supplies 600 megawatts of power to the San Francisco region.

Potential geothermal energy sources have been identified in 33 States and are believed to exist in other States in the country where little exploration or drilling has been done. Some of these sources are already being developed to produce electric power and heat for local needs.

Three principal kinds of geothermal energy resources are available for possible exploitation before the year 2000: hydrothermal (vapor and liquid-dominated), geopressurized (including dissolved natural gas), and hot dry rock. Vapor-dominated hydrothermal resources, such as the Geysers, are thought to be rare. Some liquid-dominated hydrothermal resources are believed to be economically competitive with use of current production technology. The commercial potential of geopressurized and hot dry rock is more speculative, but these resources could have large benefits.

STRATEGY FOR GEOTHERMAL RESOURCES

The Administration's current program for geothermal energy takes account of the different states of technical readiness and economics of the various geothermal technologies. Specifically, the U.S. will:

- Encourage the commercial development of hydrothermal resources in the near and mid term through use of economic incentives, demonstrations, resolution of environmental problems and removal of institutional barriers;

- Increase the technical understanding needed to begin use of hot dry rock and geopressurized resources (including the recovery of entrapped methane).

If these efforts are successful, geothermal sources could supply significant quantities of energy by the year 2000, as Table VI-4 indicates. While the quantities represent only a small part of the Nation's overall projected energy consumption in 1985 and 2000, geothermal energy could account for a large fraction of energy use in some regions, such as the West Coast. Post-2000 use, though very uncertain, could be quite large.

Table VI-4

Estimated Geothermal Utilization
(Quads per Year)

Resource	Application	1985	2000
Hydrothermal	Generate electricity	0.08-0.3	0.6-3.0
	Provide direct heat	0.02-0.2	0.5-2.0
Geopressurized	Generate electricity and produce methane	0-0.02	2.4-4.0
Hot Dry Rock	Not estimated		

Hydrothermal Resources

Hydrothermal resources are systems of hot water or steam (or both), which are trapped in fractured rocks or porous sediments overlain by impermeable surface layers. These hydrothermal resources have been heated by contact with relatively shallow masses of hot rocks. When tapped by drilling, they can generate both electricity and thermal energy for space heating, industrial processes, and agricultural uses.

Many promising hydrothermal reservoirs have been identified, primarily in the Western States. These are principally high temperature reservoirs which can be used to generate electricity. Many are considered to be commercial today. Modest demonstration programs will be aimed at expanding the use of these commercial reservoirs by lowering the cost of production.

Hydrothermal reservoirs for space heating and cooling and for process heat should be economic in many regions. Energy from such resources is estimated to be equal to or greater than the Nation's demand for space and process heat. But these reservoirs are located far from population centers; projects are not perceived as profitable by resource development companies; and potential users are not accustomed to risky exploration. Consequently, there has been little exploration or development of geothermal resources, nor has a supporting structure for the industry been created.

To stimulate this use of hydrothermal, the Federal response will include:

- Loan guarantees and tax incentives to encourage the flow of equity capital and reduce the risks to lenders;
- RD&D programs (including cost sharing in specific demonstration projects) to address technological and environmental problems;
- Actions to reduce institutional uncertainties, including direct support to regional planning activities;
- Conduct of Federal land management and other regulatory functions in a timely manner; and
- Cost-sharing and technology transfer subsidies aimed at potential government, utility, and industrial users.

Other measures are being considered to streamline the Federal licensing and permitting process and to break down legal barriers. An interagency group is reviewing current regulatory procedures, including the environmental approval process. A project is being conducted through the National Council of State Legislatures to resolve problems with state and local laws. Measures are also being considered to expand the economic incentives.

The uncertainties that hamper rapid development of hydrothermal resources concern reservoir characteristics (such as the quality and flow of hot fluids) and the economics of energy production. The Department of Energy's reservoir confirmation program includes cost-shared well drilling with nine participating companies.

Better information about a few of the most promising reservoirs should be available by the early to mid 1980s. The Department of Energy is also sharing costs with industry for several experimental and demonstration facilities for both electric utility and direct heat applications. These projects include a large (50 MWe) electric power plant demonstration and various smaller projects for space heating, agricultural, and industrial uses.

Although existing extraction and conversion technologies have been used extensively abroad, they have not been demonstrated in the U.S. While it is anticipated that existing environmental control technology will be adequate, this has yet been demonstrated. Government-and-industry projects will be important not only as a source of operating data, but also to gain experience and information on these environmental issues.

Major improvements in technology and economics will be required to make use of moderate-temperature resources on a scale sufficient to meet the estimates in Table VI-4 of geothermal use in the year 2000. While no major technological advances are required for direct heat use, resource confirmation will have to be done on a major scale, and present market imperfections will have to be resolved. The Department of Energy is funding R&D to reduce drilling costs, to develop advanced conversion systems capable of using moderate-temperature high-salinity resources, and to develop better techniques for predicting reservoir performance under operating conditions.

Funding for the hydrothermal program is $71 million in FY 1979 and $59 million in FY 1980.

Geopressurized Resources

Geopressurized resources are hot water aquifers containing dissolved methane trapped under high pressure in sedimentary formations along the Gulf Coast. The supply of dissolved methane included in the resource is highly uncertain. Estimates of the dissolved methane range from 5,000 trillion to 63,000 trillion cubic feet (TCF).

The strategy places emphasis on the recovery of the methane gas trapped in the geopressurized water. Because of its relatively low temperature, the thermal energy and hydraulic pressure are not economically recoverable in the near term without methane recovery. However, high well costs and existing state conservation laws may make it necessary to recover them together. Recovery of the thermal energy and pressure in the geopressurized resource is technically similar to the recovery of moderate-temperature hydrothermal energy. If the geopressurized resource proves to be economically viable, the technology for it can draw heavily on the hydrothermal program. The program for geopressurized resources will:

- Establish the size of the resource base.
- Narrow the range of uncertainty about the costs of recovery, and by extensive drilling and testing, determine the number and size of geopressurized reservoirs and the mechanics of water and gas production.
- Define the environmental effects and the costs of moderating them, especially subsidence and the disposal of spent liquids.
- Obtain industrial commitment to geopressurized resource development with a program of phased incentives tied to the level of uncertainty.

Funding for the geopressurized program is $28 million in FY 1979 and $36 million in FY 1980.

Hot Dry Rock Resources

Hot dry rock resources are geologic formations at accessible depths that contain considerable heat but little or no water. The resource is estimated to be very large (conceivably inexhaustible), and its exploitation could eventually be significant. The strategy is to develop the technology for exploiting the hot dry rock resource now so that it could be commercially deployed around the year 2000. Basic geoscience research and technology R&D in this area has stimulated increasing international interest and cooperation.

Basic to the extraction of energy from hot dry rock is the creation of a circulating fluid loop through the hot rock by fracturing it. The fractures provide a large heat-exchange surface for recovery of the heat. Operation of the energy extraction loop at the Los Alamos Fenton Hill site is being used to gather system performance data, evaluate loss of fluid, measure energy input requirements, and generate information for future development.

Funding for the hot dry rock program is $15.5 million in FY 1979 and $15 million in FY 1980.

C. Fusion

The continuing interest in fusion as an energy source derives from the essentially inexhaustible character of its fuel supply and environmental advantages over nuclear fission. One type of fuel, deuterium, exists naturally in sea water; other types are readily available or easily synthesized. Since fuel handling and waste managment problems are less serious than for fission, fusion is considered more environmentally attractive.

Formal research on fusion energy began in the early 1950s as a part of the defense program. Scientific progress has been considerable, but more must take place before it is possible to assess the engineering potential of individual fusion systems. Environmental issues, including problems of radioactive emissions and long term waste management, must also be addressed.

Currently, two different concepts for fusion are being developed--magnetic confinement and inertial confinement. With magnetic confinement, the fusion reaction takes place in a very hot gas (plasma), contained by a magnetic field. With inertial confinement, small pellets of fuel are bombarded with high energy laser beams or similar concentrated energy beams. The compression and heating of these fuel pellets initiate the fusion reaction.

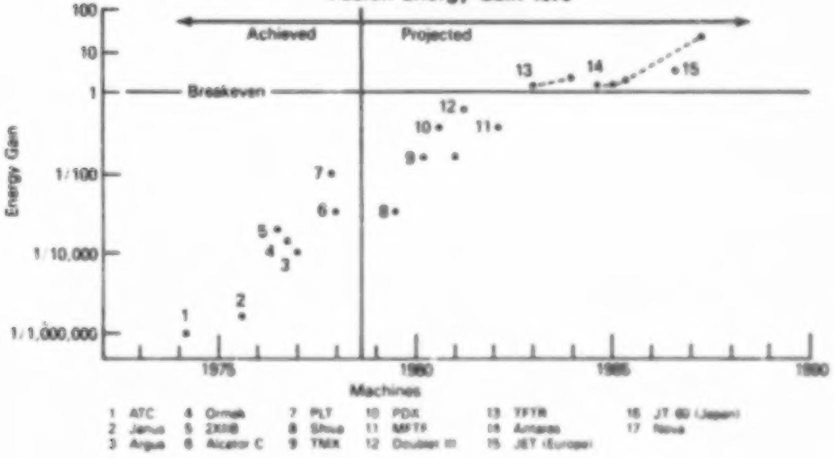
STRATEGY FOR FUSION

As its long-term objective, the Administration's fusion program seeks to develop systems that can produce central station electric power. Other uses include the production of alternative fuel forms, such as hydrogen and fission. The program aims eventually to realize the most promising commercial opportunities for fusion. Currently, efforts are directed to near-term scientific objectives, and progress is measured by the quality of information being developed.

Current fusion research seeks to create and contain high-temperature plasmas, and to understand their characteristics. A fundamental problem arising from this research is the need to develop accurate scaling laws that can be used to design larger experimental systems.

Two benchmarks of progress in fusion development are the concepts of increasing "energy gain" (the ratio of energy out to energy in) and "energy breakeven" (the point at which as much energy is released from fusion plasma as is used to create fusion). The success of various experiments to achieve "energy gain" is illustrated in Figure VI-1. Recent results have been very encouraging, but development of a commercial reactor still faces major hurdles.

Figure VI-1
Fusion Energy Gain 1978



The fusion program must eventually advance from the current applied research phase to the technology development phase, in which more detailed engineering and commercial decision-making is required. The applied research aims at demonstration of scientific feasibility, or "energy breakeven," and development of a capability to sustain fusion reactions.

Future Program Direction

The major planning issues concern the pace and variety of new technology experiments and demonstrations.[1] With limited resources, the fusion program confronts a choice between rapid movement emphasizing only a few options and slower movement emphasizing many options. At one extreme, an early decision could be made to concentrate resources entirely on one technology, despite considerable technical uncertainty. The objective would be to produce early results with minimum R&D expenditures, but the risk of complete technical or economic failure would be high.

At the other extreme, many technology options could be pursued to reduce uncertainty and create alternative choices for a later commitment to one or more commercial designs. The possibility of technical or economic failure is minimized at the risk of redundant experiments, delayed results and higher R&D expenditures.

The Administration's fusion strategy seeks to maintain multiple options and decision points. If carried to completion, the strategy would move through the following phases:

- Demonstration of Scientific Feasibility. The Tokamak Fusion Test Reactor (TFTR) is expected to demonstrate the scientific feasibility of the magnetic confinement approach by 1983-1985. Either the Nova project or the Antares project could demonstrate scientific feasibility of the inertial confinement approach by the 1985-1987 period.

- Technology Development. Engineering test facilities would be constructed for the most promising magnetic and inertial concepts. Earliest possible operation is 1992-1995 for a magnetic system and 1995-1998 for an inertial system.

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[1] As an estimate, experiments and demonstrations fall into the following rough categories: Small scale laboratory tests $1 - $30 million; Large scale laboratory tests $30 - $300 million. Engineering test facility (ETF) $300 - $800 million; Engineering prototype reactor (EPR) $800 - $1200 million.

- Engineering Development. A single engineering prototype reactor would be designed based on experience with the test facilities in the early 1990s. A choice would need to be made between the two concepts. The earliest operation of the reactor is projected to be about 2005.

- Demonstration and Commercial Capability. After commercial demonstration, an operational capability of 0.1 to 0.2 quads might be possible as early as 2025.

This outline is intended as a strategic basis for program planning. It gives shape and direction to the program, guidance for near-term activities, and most important, a preliminary definition of the key decision points. While dates have been tied to the design of an engineering test facility decision, they are flexible. If the decision were to be made on the magnetic option in 1983-1985, the only available U.S. experience with a large-scale laboratory experiment would come from the Tokamak concept. Additional information would be available from the extensive fusion research being conducted in other countries.

The general conviction among those familiar with fusion technology and research is that a commercial fusion reactor will not be achieved without major technical and engineering advances, even after a firm scientific foundation has been established. While such a breakthrough could occur with a major advance in a particular subsystem or technology component, it is more likely to require development of a whole new concept.

Thus, while scientific feasibility is essential, such feasibility does not necessarily lead to engineering or economic success. The initial concepts that support a determination of scientific feasibility may have serious engineering or economic problems. For this reason, the fusion program must continue to examine some of the more promising alternative concepts, even after feasibility is demonstrated. The Department of Energy may decide to defer construction of engineering test facilities to permit development of adequate information on other fusion alternatives. The funding for fusion technology in FY 1979 and FY 1980 is significant, as Table VI-5 indicates.

Table VI-5.

FUNDING FOR FUSION TECHNOLOGY
(Million dollars)

Technology	FY 1979	FY 1980
Magnetic Confinement	$356	$364
Inertial Confinement	144	146
Total	500	510

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D. A Strategy for Inexhaustible Resources

The Department's strategy to prepare for the eventual transition to inexhaustible energy sources embraces the breeder reactor discussed in chapter V, and the solar, geothermal, and fusion technologies described in this Chapter. Each of the technologies has its own strengths and weaknesses. Some, such as fusion and hot dry rock geothermal, have not yet been shown to be technically feasible. The breeder reactor has raised a number of safety, environmental, and proliferation problems. For all the technologies, the economics are uncertain.

The choice of long-term supply technologies will profoundly affect the character of the Nation's energy distribution system. Many (though not all) of the inexhaustible technologies produce electricity rather than liquids or gas. That is an inherent characteristic of the technologies themselves rather than a policy choice, but it has major consequences for the Nation's energy future. The breeder reactor, fusion, and even some of the solar technologies--including OTEC and some solar thermal power systems--are suited for large scale centralstation applications. Other solar technologies--photovoltaics and wind, for example--are smaller in scale and can generate electric power on a decentralized basis. Still other solar technologies, such as biomass and thermal energy for residential and industrial heating, are appropriate for site-specific applications.

If more oil and gas sources can be developed at reasonable prices, the market for electricity--and many of the inexhaustible technologies--will be more limited. If traditional fuels are scarce, however, there will be greater pressure for electrification using inexhaustible sources. The mix between central station and decentralized technologies in production of this electricity will depend on system considerations, economics, environmental impacts, and social preferences.

As Table VI-6 shows, the Department of Energy's budget for development of renewable and inexhaustible energy supplies is considerable. The Federal government has a responsibility to assure that this money is well spent. Individual projects cost tens or hundreds of millions of dollars each. The pacing and design of a single program can affect the Department's overall funding levels for years to come.

Table VI-6

DOE FUNDING FOR INEXHAUSTIBLES
(million dollars)

	FY 1979	FY 1980
Breeder Reactors	$ 742	$ 590
Solar Energy[1/]	568	657
Geothermal	158	141
Fusion	500	510
TOTAL	1968	1898

Yet there is also a responsibility not to foreclose major supply options at this time. The Federal government must seek to develop a number of safe, environmentally acceptable energy options for future generations. With that commitment firmly made, the Nation is likely to experience a smooth and secure transition to new sources of energy.

[1/] Excludes funding by other government agencies and tax credit expenditures.

CHAPTER VII

MAKING DECISIONS PROMPTLY AND FAIRLY

Almost overnight, the world energy problem created a new agenda of public issues. Suddenly, there is an urgent need for global, national, State, and local management of energy decisions. The U.S. must prepare for sudden supply emergencies. It must pursue new energy projects and expanded production even as environmental constraints become more stringent. And economic security and equity for all Americans become critical concerns as rising world oil prices threaten an improved U.S. standard of living. These and other aspects of the energy problem will test the strengths and weaknesses of democratic government.

The Nation must find ways to debate openly the issues on its energy agenda without sacrificing its capacity to make final decisions. It must make decisions in a careful but timely manner--before, not after, the problem worsens. Regulatory delays and legislative stalemates bring unintended policy outcomes and threaten the Nation's ability to manage the energy transition. Certain directions will be fiercely debated, and perhaps rejected. No one will be served, however, if the country cannot agree on any directions at all.

This Chapter addresses the management of energy decisions and the institutional response to the energy problem. There are many dimensions to the successful management of energy problems. Some programs must deal with future supply interruptions or other shocks. There must be programs to address the consequences of the current Iranian shortfall. Other programs must address the need for more streamlining and less confusion in the energy decision process. Still others must grapple with the problems of fairness in energy policy. In general, they seek to establish a process for representing and reconciling the interests of the Federal government, States, local government, industry, and private citizens in major energy decisions.

A. Managing Future Energy Crises: Emergency Planning

An energy strategy must deal with the threat of embargoes and emergency supply interruptions, as well as with the long-run tightening of world oil markets. Just as individual citizens, who must plan for possible adversity in their own lives, can often join with others similarly threatened to share risks and thereby limit them, the Nation, which must have a strong domestic plan for dealing with future crises, can gain by joining in concerted action with other consuming countries.

PLANNING AT THE INTERNATIONAL LEVEL

In 1974, the U.S. most other member-nations of the Organization for Economic Cooperation and Development (OECD) agreed to cooperate on energy matters through a new international organization, the International Energy Agency (IEA), which has become the principal institutional framework through which the major industrialized energy-consuming countries are working together to reduce their collective and individual dependence on imported energy (particularly oil). The basic aims of the IEA--in which the United States has assumed a strong leadership role--are to:

- Reduce excessive dependence on oil through energy conservation, development of alternative energy sources, and energy research and development;
- Promote cooperative relations with oil-producing countries and with other oil-consuming countries with a view to stabilizing international trade in energy;
- Maintain a permanent framework for consultation with oil companies;
- Promote a comprehensive system of information on the international oil market; and
- Plan common measures to meet oil supply emergencies and disruptions and to share available oil supplies in the event of such emergencies.

Since the creation of the IEA in 1974, considerable progress has been made towards the achievement of these basic goals.

In October 1977, for example, the Ministers from Member Countries agreed to:

- Endorse a set of Principles for Energy Policy to guide IEA countries in implementing national energy policy measures;
- Limit total oil imports to IEA countries as a group to not more than 26 million barrels per day by 1985, and to set further group objectives for subsequent years; and
- Periodically review each country's contribution so that, if necessary, national energy policies could be strengthened further in order to achieve the IEA group objectives.

IEA's emergency oil-sharing program has received greater public attention than the longer-term actions. The oil-sharing system set up by IEA presumes that in the event of a major disruption in oil supplies, each nation would make an equal sacrifice in both conservation and the allocation of available oil. When triggered, the plan calls for each country to activate a set of emergency demand-restraint measures to reduce consumption by the amounts specified in the agreement.

PLANNING AT THE NATIONAL LEVEL

The Nation's strategy emphasizes development of a large government-owned oil reserve and various stand-by mandatory conservation measures, such as gasoline rationing, for use in emergencies.

The Strategic Petroleum Reserve

When completely filled, the Strategic Petroleum Reserve (SPR) will contain 1 billion barrels of oil; it will be the largest government-owned oil reserve in any industrial country. (Only four other countries currently have any such reserve.) As planned, the SPR would be capable of meeting most embargoes and emergencies, including a major oil shortfall of up to 6 million barrels per day--two-thirds of the Nation's imports--for up to 6 months, or a shortfall of 3 MMBD for a year. The Department of Energy will soon have about 95 million barrels stored in salt domes in the Gulf area, roughly 10 percent of its ultimate target. Effective use of SPR in an emergency could prevent sudden curtailments of energy use and the economic damage that such curtailments often create.

The larger the Reserve grows, the greater will be its deterrent value. By mitigating the economic damage of an embargo or other interruption, the SPR can buy the Nation time to resolve the problems underlying the supply interruption. Potential adversaries would recognize that the Reserve can protect the U.S. for so long a period that a potential embargo on their part would bring unacceptable losses of revenue to the producer countries.

The smaller the Reserve, the less its deterrent value. The Nation would be reluctant to offset fully any immediate loss unless the Reserve were known to be large enough to meet the country's needs for a considerable period.

With the high U.S. import dependence that is projected over the next decade and beyond, a billion-barrel Reserve will be valuable insurance in almost any energy future. Indeed, if world prices are low, U.S. oil imports would increase and maintain their current share of total U.S. energy consumption. Without greater import diversification, the U.S. could find itself equally vulnerable or even more vulnerable in the mid-term.

Emergency Conservation Plans

In addition to the SPR, the Administration has developed various stand-by mandatory conservation plans for use in case of severe supply interruptions or to meet U.S. obligations in the IEA oil-sharing agreement.

Recently, the President submitted to Congress a gasoline rationing plan and three stand-by conservation plans. Stand-by plans for restricting weekend sales of gasoline and for mandatory thermostat settings in non-residential buildings are discussed in the context of the Administration's response to the Iranian oil shortfall.

The gasoline rationing plan would be used only as a last resort during a supply interruption more serious than the current Iranian shortfall. Indeed, gasoline rationing probably would not be invoked unless the U.S. supply shortfall were well in excess of 10 percent. Under the plan, the Treasury would issue gas rationing checks (denominated in gallons of gasoline rather than dollars) on the basis of State motor vehicle registrations. The checks would be redeemable for coupons at banks and other specified locations. All passenger cars would receive the same allotment, regardless of differences in their fuel efficiency.

Trucks and buses would receive larger allotments. Priority allotments would go to essential public services -- police and fire vehicles and ambulances. Individuals with needs smaller than average could sell a portion of their coupons in a "white market" allowed for such purposes.

Once the current "pre-implementation" work for this system has been completed, it would be possible to put gasoline rationing in effect within 90 days. Almost inherently, no such system can be completely fair, sensitive to the needs of each individual family and driver, especially when it is intended for emergency circumstances. At best, it can achieve only rough equity, and for that reason, among others, the U.S. should turn to gasoline rationing only as a last resort.

B. Managing the Current Shortfall: The Iranian Response Plan

The disruption in world oil markets caused by the recent loss of Iranian supplies is not severe enough to require gasoline rationing or other measures equally extreme. With certain voluntary and administrative measures to encourage conservation and fuel-switching, the U.S. can meet the supply shortfall without overreacting or drawing down its inventories unduly.

THE INTERNATIONAL RESPONSE

Last month, the President instructed his delegation to the International Energy Agency to seek international cooperation to reduce petroleum consumption. Sharing the shortfall helps ensure that neither the United States nor any other nation will bear a disproportionate share of the burdens associated with the loss of production from Iran.

On March 1 and 2, at a meeting of the IEA Governing Board, the United States and the other IEA member-nations entered into a joint agreement to reduce oil import demand by 2 million barrels per day (MMBD), roughly 5 percent of IEA consumption, by the end of 1979. To achieve this goal, each country will adopt programs of its own choosing.

The agreement among member countries calls for reexamination of the actual level of savings required as international oil supply and market conditions evolve. The agreement also provides for review of the individual programs that member countries adopt. A meeting of the Governing Board on May 4, 1979, provided a forum for review of these plans and for assessing the prevailing oil supply and demand situation.

THE NATIONAL RESPONSE

The U.S. share of the agreed-to savings ranges up to 1 million barrels of oil per day. To ensure that the U.S. can meet these targets the President has announced the following measures:

- Mandatory Building Thermostat Settings. The President asked the Congress to approve quickly a standby mandatory conservation plan that would require thermostats in non-residential buildings to be set no higher than 65° in winter, and no lower than 80° in summer.

  The President sent the plan to Congress on March 1, 1979, pursuant to Section 552 of the Energy Policy and Conservation Act. By law, Congress has 60 legislative days -- or until May 14 -- to act on the plan. The President called for earlier action by the Congress.

The President announced his intent to implement this plan as soon as Congress approves it. It is estimated that, when implemented, this measure will reduce demand for imports by 195,000 to 390,000 barrels per day by the end of 1979.

- Voluntary State Actions to Reduce Gasoline Consumption. The President will set state-by-state targets for curbing gasoline consumption. Each state will be asked to implement voluntarily a plan of its own choice to meet these targets. The President indicated that he hopes these voluntary actions will avoid any need for mandatory action and will achieve needed oil savings.

- Mandatory Weekend Closings of Gasoline Stations and Alternative State Plans. If the voluntary state reductions do not achieve adequate savings, and if shortages of gasoline exist, mandatory measures would be imposed. The President transmitted to Congress on March 1 a plan seeking standby authority to mandate closing of gasoline stations for all or part of the weekend. If this plan were implemented, this measure would save an estimated 120,000-235,000 barrels per day by the end of 1979.

  The President recognized the difficulties implementation of this plan would cause in some states, particularly those with economies that are heavily dependent on tourism. After extensive consultation between Department of Energy and State officials, the President submitted an amendment to the plan under which states would be permitted to develop alternatives to the federal standby weekend closing plan.

  If mandatory closings are required, States first would be permitted to develop their own alternative plans and would submit them to the Department of Energy for approval 30 days prior to implementation. A state would have 60 days to demonstrate that its alternative plan had accomplished its assigned target levels of gasoline savings. For any state which chose not to develop an alternative plan, or a state whose plan failed to achieve the specified level of savings, the federal weekend closing would automatically go into effect.

- Electricity Transfers. Significant savings of imported oil can be realized by using electricity generating capacity available at plants powered by coal to replace oil-fired electrical generating units. The President urged all of the Nation's utilities to cooperate with the Department of Energy to make maximum use of excess non-oil-fired generating capacity.

If voluntary cooperation does not realize the savings needed to avoid oil shortages, the President stands ready to direct the Department of Energy to use the Federal Power Act to order wheeling or transfer of electricity among utilities.

The President also called upon State regulatory commissions to remove any existing regulatory impediments to the transfer of electricity.

Estimated oil savings range from 100,000 to 200,000 barrels per day, depending on the season and the overall total electricity demand. To the extent that consumers cut back electricity requirements voluntarily, more power will be available to back out use of oil now being used to generate electricity.

o Switching From Oil to Natural Gas. The President urged the Nation's utilities and other major industrial users of oil without coal-burning capability to switch to natural gas wherever possible. To facilitate this switch, the Department of Energy has:

   - Recommended a policy of short-term, direct purchases of gas by gas-capable facilities now using oil, particularly distillate;
   - Begun a survey of pipelines and distributors to identify surplus deliverability;
   - Promulgated rules to allow purchase of formerly intrastate gas by interstate pipelines; and
   - Implemented a program to help match available gas supplies with prospective users.

   Should these measures fail to ensure maximum use of the surplus, the Department will explore using allocation and other powers to ensure this fuel switching. Savings from oil to gas switching are estimated at 250,000-400,000 barrels per day, depending on seasonal natural gas demands and the availability of surplus gas. Under a maximum program, 500,000 barrels of oil per day could be replaced with natural gas beginning in 1980.

o Low Sulphur Fuel Oil. The Administration is determined to prevent environmental health regulations from being used as an excuse for price-gouging. In cases where shortages of low-sulphur fuel oil appear to exist and where states request temporary suspension of Clean Air Act standards, the Administrator of EPA will consider unusually large increases in the price differential between complying and noncomplying fuels as a basis for recommending approval of state suspension requests. The President has directed the Administrator of EPA to take into account price differentials and to provide the President with information on price differential increases when making recommendations to him on such requests. The President also will consult with the Secretary of Energy prior to making his determination.

- Deferral of the October 1 Lead-Phasedown Requirement. The current Environmental Protection Agency schedule for the phasedown of lead in gasoline calls for a standard of 0.5 grams of lead per gallon (gpg) to be met on October 1, 1979. If this schedule were fully implemented, gasoline availability would be reduced by 350,000-450,000 barrels per day. In addition, higher octane requirements for lower lead gasoline could increase refinery crude oil requirements by 30,000 to 60,000 barrels per day. The President has directed the Environmental Protection Agency to defer the phasedown to the 0.5 gpg lead level for one year, and substitute instead an 0.8 gpg standard. This substitute standard will protect those urban children most vulnerable to lead and will avoid 75 percent of the loss in gasoline production that the 0.5 gpg standard would have caused.

- Five Percent Reduction in Federal Government Energy Use. The President has directed heads of executive agencies to curb their energy use by 5 percent in the year ending March 31, 1980, excluding coal use. Activities of the Department of Defense essential to maintain operational readiness are exempt from this directive. In reaching this objective, the executive agencies are directed to:

  - Reduce their use of automotive fuels by 10 percent;

  - Effective immediately, set building thermostats no lower than 80° during the summer cooling season and no higher than 65° for working hours and 55° for non-working hours during the winter heating season;

  - Take any other steps necessary to achieve the 5 percent savings.

Estimated energy savings are 20,000 barrels of oil per day.

The government will continue to emphasize purchase of fuel-efficient autos for Federal use and energy efficiency in new buildings. In addition, $234 million is included in the FY 1980 President's budget to retrofit existing Federal buildings for conservation.

The President has called upon the Governors to take similar actions to reduce energy use at the state government level.

THE PUBLIC RESPONSE

Individual action by each citizen can help to achieve conservation goals while minimizing the intervention of the federal government into the everday life and business of Americans. The President is calling upon each and every American to make conservation an important feature of their daily lives.

The President also is calling upon every driver in the United States to reduce travel by 15 miles per week. If all drivers were to reduce travel that much, this action alone could save 450,000 barrels of oil per day. Driving fewer miles per week can be accomplished easily by leaving the car at home one day each week, and instead using mass transit, carpools, or walking, where appropriate.

THE EFFECTIVENESS OF THE RESPONSE PLAN

If each of these measures is fully implemented, the United States can reach the goal of up to a 5 percent reduction in oil consumption the President has set. This goal will fully offset the impacts of the loss of production from Iran, and will permit rebuilding the stocks of crude oil, gasoline, heating oil, and distillate needed to prevent shortages in the future.

The total savings of these various measures could reach 850,000 to 1,540,000 barrels per day. These savings will grow substantially as the incentives provided by decontrol take effect. By 1982, for example, savings from decontrol should reach 520,000 to 600,000 barrels per day.

These demand restraint measures would fulfill the U.S. commitments to IEA made in response to the Iranian shortfall, but do not represent any formal obligations of the U.S. under the terms of IEA agreement.

The Iranian Response Plan is discussed in detail in an appendix to this report.

C. Managing the Long-Term Energy Problem: The Institutional Framework

In many ways, Americans seem to be able to cope with sudden crises better than they deal with persistent, long-term problems. Although short-term problems may dominate for the moment, the long-term problems will remain after the headlines have shifted to other topics. It is crucial that effective mechanisms be available to deal with those long-term problems.

CARRYING OUT INTERNATIONAL RESPONSIBILITIES

Through the IEA, and through a series of bilateral agreements, the United States is working with other consuming countries toward a more satisfactory energy future. For example, IEA countries are seeking to limit their collective oil imports to 26 million barrels per day in 1985. The IEA reviews the adequacy of member country energy policy contribution toward the achievement of this objective. In addition, agreements for the exchange of scientific information, both in the IEA and bilaterally, can help advance new technologies.

CARRYING OUT NATIONAL RESPONSIBILITIES

The energy organizations and procedures which existed in the early 1970s were forged in an era of stable and abundant supplies of cheap energy. When tested by the pressures of this decade, they were found wanting. Institutions became paralyzed and indecisive. *Ad hoc* arrangements were made.

Getting the Government's House in Order

Until the formation of the Department of Energy, the confusion of Federal energy programs mirrored the national confusion on the energy problem. Diverse organizations, with different legislative mandates and constituents, pulled in different directions.

The creation of the new department afforded, for the first time, an opportunity to bring together in a consistent way the development of energy policy and the implementation of regulatory, research and operational responsibilities.

In a period of debate over future policy directions, the new Department has a mandate broad enough to avoid a mission-oriented commitment to one set of energy technologies. Regulation, research, technology development, and commercialization programs are more likely to harmonize with changing specific concerns in the near-term and mid-term periods. The creation of a new cabinet agency for energy--as both the energy problem and the energy debate have intensified--has not been easy. Yet the need for a coordinated authority to carry out the Nation's energy strategy is nearly as critical as the strategy itself.

Expediting Energy Decisions

The process by which energy projects are approved or permitted has become needlessly complex. That process should ensure the careful and deliberate consideration of all relevant factors, particularly protection of the environment. However, when the process has been completed, and a project has been found to have merit, the Federal government must have the capacity to act--and the national interest must at some point supercede private or special interests seeking to block such projects.

In recent years, many important new energy projects--such as pipelines, seaports, and refineries--have become entangled in complex Federal and State permitting processes. In some cases, the Federal government can expedite decisions simply by putting its own house in order. It can streamline or consolidate various authorities to ensure that decisions can be made in a reasonable time.

In other cases, such as the Alaskan oil and gas pipeline and the Sohio pipeline project, the Federal government may be required to take special action to break the impasse. Consistent with reasonable local requirements, the approval of projects with major national importance should receive the highest priority.

Delays in permitting increase the costs of new energy projects. They can lead to unintended policy outcomes and undesirable energy uses. For example, obsolete oil-burning plants may stay in service long after they should be retired because new powerplants have not come on line as scheduled. Coal is a critical transition fuel, but today a new coal-fired powerplant in one state requires nearly 30 permits. The costs of nuclear power have spiralled in part due to regulatory delays that have no relation to the proper consideration of safety or environmental issues. The permitting problems for coal, nuclear, and other energy supplies are likely to worsen as the more benign sites for new energy facilities are taken.

The number of permits required itself poses a significant problem. Many such permits are relatively easy to obtain, but each additional new permit requirement can add more cost and delay. Since these new permit requirements apply only to facilities that do not yet exist, no organized constituency has a strong interest in opposing the new requirements. All levels of government and all interests claim a right to be consulted in the decision to build a facility, and they frequently exercise that right by imposing new permitting requirements. Delays from this proliferation of permits must be stopped if transitional energy supplies and new technologies are to be brought on as needed.

Federal Permit Deadlines. The President will sign an Executive Order instructing the Office of Management and Budget (OMB) to establish and administer a system to set deadlines for Federal decisions on critical energy facility permit applications. The President is urging states to set strict timetables for their permitting actions. The system will work as follows:

- OMB will establish and administer a system of deadlines for decision making by non-independent Federal regulatory agencies on non-nuclear energy facilities that the President considers critical. This review will not in any way change the statutory responsibilities of the agencies.

- OMB will require each reviewing Federal agency to submit certain information on each project selected. The required information may include:

    - Estimated dates for submission of complete Federal applications from project sponsors;

    - Target final Federal decision dates on each significant permit or statutory review;

    - Actions required of other Federal agencies and non-Federal authorities to allow final Federal decision;

    - Further action required of the applicant to allow final Federal decision; and

    - Semi-annual or more frequent progress reports, including specific reasons for any slippage in target final Federal decision dates.

- On the basis of the information submitted, OMB will suggest to the President deadlines for Federal actions for each facility, and keep the President informed of agency performance in meeting those deadlines.

- OMB will assure that, as much as possible, multiagency reviews are conducted cooperatively and concurrently.

- Because state permits are critical to moving energy projects forward, OMB will seek joint review processes between Federal and State bodies where necessary.

Legislative Responses. In some instances, new legislation will be required to streamline processes or to expedite worthwhile projects. The Administration supports legislation, discussed elsewhere in this report, to reduce the unnecessary and duplicative steps in siting and licensing nuclear power plants, without in any way compromising safety. To this end, the President has directed the Department of Energy to work with California officials and Congressional committees to secure enactment of Federal legislation which will ensure that the Sohio pipeline can be built, while protecting both air quality and the concerns of state and local governments.

Loan Guarantees. The President has directed the Department of Energy to submit to Congress a proposal to streamline DOE's current authority to issue loan guarantees for a broad range of energy technologies. DOE must have the flexibility to provide timely financial incentives to permit early demonstration of important but commercially unproven energy technologies. With this authority, a range of technologies could be demonstrated, at little or no cost to the Federal government. The technologies eligible for loan guarantees range from renewable energy sources to high BTU coal gasification projects.

CARRYING OUT STATE AND LOCAL RESPONSIBILITIES

In recent years, State, regional, and local governments have assumed a broad range of new energy responsibilities. The requirements that States administer energy programs have proliferated, sometimes without adequate consideration of State needs. In some cases, these programs are too narrowly focussed to address important State energy concerns. In other cases, legislation has imposed responsibilities--such as for residential conservation, and emergency planning--on States but did not authorize funds to carry out those responsibilities.

Both the States and local governments should be full partners with the Federal government in designing the Nation's energy strategy. States and local governments can play a vital role as "laboratories" in trying out new conservation and supply initiatives. States and local governments also generally are better situated than the Federal government to deal with energy problems at specific sites. As in U.S. environmental policy, many of the powers needed for effective action on the Nation's energy problems are those traditionally reserved to the States or local governments. Planning and siting for energy facilities is one. Others are implementation of minimum conservation standards for new buildings, and design of utility rates. Furthermore, States in different regions of the country confront different types of energy problems. In addressing many regional energy problems, cooperation among States is important.

Last year, the Administration offered legislation to improve planning and management of State energy activities, and will propose similar legislation this year. The Energy Management Partnership Act (EMPA) will help the States develop their energy planning and management capabilities. EMPA will consolidate these existing Federal grant programs, and will give States more resources to carry out energy activities within the framework of an overall State energy management plan. The bill would authorize $110 million annually over five years.

EMPA would eliminate a number of existing mandatory State responsibilities while imposing new requirements in the area of energy planning, emergency preparedness and use of renewable resources. States could emphasize individual projects and program actions to encourage State-level conservation and renewable resource development, and seek to remove barriers and address other site-specific problems that hinder conservation and renewable resource development within the State. States also would set measurable goals for conservation and production and evaluate their progress toward those goals.

Through EMPA, the Federal government also would recognize the expanding energy role of local governments. Local governments have many energy and energy-related responsibilities. Some of these include traffic, local transportation, zoning and facility siting, building codes, and in some cases, lighting standards, emergency planning functions and outreach activities.

EMPA would require States to "pass through" financial assistance to local governments to match their responsibilities in the State energy plan. The States also must involve the local governments actively in developing these plans in the first instance. Furthermore, the new legislation would authorize $5 million annually over five years for special energy projects to be undertaken by local goverments and Indian tribes. These special projects could serve as demonstrations or models or creative new approaches to local energy problems.

Finally, EMPA will permit States to consolidate applications for assistance programs administered by the Department of Energy, which gives States greater flexibility in using program administration funds.

The Administration believes strongly that the national energy problem requires the concerted action of all levels of government acting in partnership. Enactment of EMPA is critical to the creation of that artnership.

D. Fairness in Energy Policy

There is nothing fair or equitable about the impact of rising world oil prices on U.S. citizens. Price increases add to inflationary pressures, slow economic growth, and affect the U.S. standard of living. In short, working Americans and their families--and especially those who are less well off--would bear the brunt of world oil prices hikes. Artificially low prices on domestic supplies would do nothing at all to reduce this problem. On the contrary, they would encourage industry and consumers to use traditional oil and gas resources even faster. The inevitable transition to higher-cost energy supplies would come ooner, and the Nation would be less prepared for that transition.

The most equitable or fair energy policy is one that seeks to limit the economic damage from the long-term rise in world oil prices. Conservation, fuel-switching and production of oil substitutes are the main instruments to protect that basic economic security to which every American is entitled.

But in a world of higher energy prices, more must be done to ensure fairness and equity. First, the Nation must provide special relief for those least able to cope with higher energy prices. Second, it must develop alternatives--such as mass transit and new energy technologies--that limit vulnerability to higher oil prices, especially for those Americans now dependent on automobiles. Third, it must ensure that higher energy prices do not unjustly enrich the oil industry.

In particular, the President has emphasized that his recent oil pricing decision should not unfairly increase profits of the oil industry. The windfall profits tax discussed earlier in this report would prevent excessive new revenues from accruing to oil producers. By the end of 1982, $5 to $7.5 billion in revenues that would otherwise go to oil companies will flow instead to the government to establish the Energy Security Fund. Coupled with additional receipts from the corporate profits tax, $11 to $14 billion would be available to the Energy Security Fund over this three-year period. The Fund would address some of the major welfare and equity impacts of higher energy prices. In addition to the windfall profits tax, the foreign tax credit benefits should be limited in the future.

Low Income Assistance. The removal of price controls on oil will impact all Americans, but the burden will be heaviest for low-income households, those who spend the largest proportion of their dollars on heat, electricity, transportation and other energy-related necessities. A major purpose, therefore, of the Energy Security Fund will be to provide assistance to those families which will help offset the increase in fuel prices resulting from decontrol.

The President will ask the Congress to pass a portion of the Energy Security Tax revenues on to low-income households through the Energy Security Fund. This assistance program would provide an average of about $100 per year to a typical low income household.

In addition to this assistance from the Energy Security Fund, the Department of Energy has already collected $60 million from suits against refiners for oil price overcharges above the amount allowed under federal price control regulations. Over $3 billion worth of claims are still in litigation. The President has directed that, as these funds are received, they be used to assist lower-income people to the extent that victims of the overcharges cannot be identified.

No U.S. citizen should be subject to a precipitous cut-off of energy vital to his health and welfare. The President has urged states to pass legislation that would prohibit cut-off of heat and electricity during the cold winter months. Such State legislation is consistent with the Public Utility Regulatory Policy Act which encourages action to protect low-income consumers.

Finally the Administration will continue during FY 1980 weatherization grants for low-income households that have offered some protection from higher energy prices.

The Minority Set-Aside Program. DOE will begin to develop a minority set-aside program in conjunction with the Energy Security Fund. In addition, DOE will increase the volume of minority contracts. Dollar volume of DOE minority contracts by the end of 1979 is expected to grow threefold over 1977.

DOE is also creating an Office of Minority Economic Impact as authorized in the National Energy Act to provide management and technical assistance as well a loan program to enable minority educational institutions and business enterprises to participate in research, development, demonstration, and other contract activities of the Department.

Reform of Foreign Tax Credit Treatment to Oil Companies. Multi-national oil companies are receiving unjustified benefits through foreign tax credits, which cost American taxpayers millions of dollars a year. The President proposes to close loopholes in foreign tax credit treatment of these companies in two ways--one requiring legislation and the other which can be done by regulation.

The President will propose legislation which would strictly limit the United States tax credit for a foreign country's oil and gas extraction income tax to the income on which those taxes are imposed. Excess credits "earned" on foreign oil and gas extraction income would not be able to shelter other income.

The tax treatment now available to these oil companies is not needed for continued exploration and production. This legislation will move existing tax laws closer to the intent expressed by Congress in 1975 and 1976. Passage will increase the United States tax revenues by $500 million in 1979.

The President feels strongly that at a time when additional revenues will be flowing to these multi-national oil companies, it is incumbent upon the Congress to pass this legislation expeditiously.

In addition, the Department of Treasury currently is reviewing regulations to tighten the foreign tax credit for oil and gas income, by laying down reasonable principles to govern the rules for distinguishing foreign income taxes (which may be credited against United States income taxes) from royalties and excise taxes (which may be taken only as deductions).

E. Public Participation in the Development of Energy Policy

If a workable energy policy ever is to be achieved in the United States, both the policy and its development must be founded on a common understanding of the nature of the energy problem and on an agreement on the appropriate solutions. An important step in developing such understanding and agreement is to involve all sectors of society both in making decisions about what the policy should be, and in executing it.

To involve the public in the development of the second National Energy Plan, the Department of Energy conducted a thorough outreach effort. Two sets of public meetings were held and written comments were solicited.

First, during the week of November 27 through December 1, 1978, DOE conducted a series of six seminars in Washington, D.C. Each seminar offered an opportunity for substantive policy discussions between DOE staff and invited representatives of the major constituency groups concerned with energy policy. Separate sessions were held with energy producers, consumers, state and local government agencies and instrumentalities, business (including small business) and large industrial users, environmental groups, and labor.

These seminars were followed in December by a series of six public hearings on NEP-II throughout the United States: in San Francisco, Dallas, Denver, Omaha, Boston, and Washington, D.C. Each of these meetings opened with a half-day morning session on the goals of energy policy. An overview of NEP-II and discussion by a panel of participants invited to represent different views within the region was followed by comments from the floor. In the afternoon, selected topics of particular interest to the region were addressed in similar panel-and-floor-discussion formats. The balance of the sessions was reserved for presentations by individual citizens, and for interactions between those citizens and the panelists.

Finally, when the time approached for Presidential decisions, senior Administration officials consulted informally with members of Congress, representatives of state and local governments, and environmental and other interest groups.

The views expressed during preparation of the Plan reflect the diversity of interests and concerns of the people of the United States. One of the reasons consensus on the appropriate direction of energy policy has been elusive is the lack ot a common understanding of the nature and severity of the energy problem. Not surprisingly, most of those who held opinions strongly enough to take the time to appear or to write were of the view that the problems associated with energy are severe, although they did not agree on the nature of those problems. Participants expressed concern with different aspects of the problem: the high level of imports, their attendant cost, and U.S. vulnerability; costs of energy to the consumer, especially to rural Americans and the poor; the long-run depletion of traditional resources and the need to plan the transition to nontraditional energy forms; and how energy development affects the environment.

Nor, given the different perceptions of the problem, did all participants agree on the appropriate solutions. A substantial number urged that energy prices be held down by controls to protect consumers. Others felt that Federal controls have not been successful, and that there should be some movement--perhaps in stages--toward more market-oriented solutions. Yet many recognized that market solutions, while advancing the goals of both conservation and additional domestic production, could have unwanted effects on the poor and on others unable significantly to alter their energy consumption.

There was some ambivalence over the proper role of the Federal government in energy policy. There was a general tendency to favor less government involvement. Yet when concern was expressed that a particular objective was not being met, the solution proposed often called for a greater government presence. On balance, the public seems to look to the government for leadership rather than excessive involvement.

There was general agreement that existing regulatory processes tend to be slow, cumbersome, and unresponsive. As part of its larger program of regulatory reform, the Administration has proposed a number of measures to streamline regulatory processes and to remove institutional barriers to energy conservation and production, without sacrificing the opportunity for full consideration of legitimate but competing policy objectives.

A number of participants advocated the adoption of particular solutions or technologies. There were repeated calls for increased conservation, for increased domestic production of traditional sources, and for rapid development of renewable resources. These are all features of the President's program.

Regardless of their basic policy positions, many participants stated a view that suggests a fundamental strength of this diverse nation. When presented with a clear and present threat to the National security and the American way of life, the public is willing to work and to sacrifice to achieve larger National objectives.

It is too much to ask that individual citizens, appearing so briefly in a fairly structured framework, address all the tradeoffs, complexities, and uncertainties of energy policymaking. They did not do so. Ultimately, the responsibility for balancing all these considerations rests with the Administration and with the Congress. This report, in fact, is devoted precisely to that balancing. But that process should be informed by the views expressed by the public in forums such as the NEP-II hearings or similar kinds of meetings.

Public participation in shaping and implementing energy policy is not limited to formal hearings and seminars on NEP-II. DOE has held over 50 public hearings on different aspects of the implementation of the National Energy Act, passed last autumn. Additional hearings and mechanisms for public participation will be available as the Nation continues to develop its energy policies.

Finally, each individual is responsible for how he or she uses energy resources. The Nation is not some mindless machine, using energy according to an abstract formula. It is millions of individuals, making decisions every day on the production and consumption of energy. Whether those uses are profligate or careful, farsighted or impulsive, will govern how the Nation weathers the energy crisis.

CHAPTER VIII

NEP-II AND THE FUTURE

The second National Energy Plan sets forth three basic principles for an effective national energy strategy:

- As an immediate objective, which will become even more important in the future, the Nation must reduce its dependence on foreign oil and its vulnerability to supply interruptions.

- In the mid-term, the twofold objectives of energy policy are to keep U.S. imports sufficiently low to protect U.S. security and to extend the period before world oil production reaches the limits of production capacity, and to develop the capability to use new backstop technologies as world oil prices rise.

- For the long-term, the objective of U.S. energy policy is to have renewable and essentially inexhaustible sources of energy available to sustain a healthy economy.

The second National Energy Plan proposes new measures that build on the accomplishments of last year's National Energy Act.

Through decontrol of oil prices, the Plan encourages greater conservation and domestic production of oil.

Through a windfall profits tax on excess producer revenues, the Plan ensures that the costs and benefits of decontrol are borne fairly and equitably.

Through tax credits and other incentives for shale oil and solar energy, the Plan accelerates the development of new energy sources.

Through proposals to streamline the management of energy decisions and approvals for new energy projects, the Plan stengthens the Nation's capacity to address a host of difficult decisions.

Through a series of immediate actions to reduce energy consumption in response to the current Iranian shortages, the Plan avoids the risk of greater emergencies and shortages.

Finally, the broad program of research and incentives outlined in the preceding chapters will ensure that new technologies can be deployed when they are needed, through policy actions carefully designed to achieve maximum benefits at least cost.

The decontrol of oil prices and the measures to encourage shale oil and solar energy are likely to reduce oil imports from 1 to 1.3 MMBD by 1985. Since the goal of U.S. energy policy is to limit the economic and political costs of oil import dependence, this Chapter examines in some detail the effect of these measures on future balances of energy supply and demand, as well as on the resulting prices of energy supplies.

In designing a sound energy future--one that will best serve the interests of all U.S. citizens--the Nation must take care to ensure equity, fairness, and economic security, without sacrifice or compromise of other important goals. New energy initiatives will affect these other national objectives, and thus the overall quality of life in the country. This Chapter, therefore, also looks at the impacts of the second National Energy Plan on the economy, employment, individuals, private capital markets and on the environment.

A. The Second National Energy Plan and the Nation's Energy Future

In the past few years, the U.S. has taken major actions to reduce its future oil import needs. The first National Energy Plan (NEA) presented a broad range of tax and pricing incentives and regulatory programs to encourage conservation, coal use, natural gas production and renewable resource development. The passage of the National Energy Act in 1978 marked a critical turning point in the country's attack on its energy problems and signified a shift toward a new set of values about energy use.

In approving the NEA, however, Congress did not complete action on several issues--such as domestic oil pricing--which could affect greatly the Nation's near-term security. Nor did the Administration or Congress attempt to resolve at one time all the policy decisions that must be made in the years ahead. As this report has emphasized, the Nation's energy policy must embrace more than a particular set of legislative initiatives in a particular year. Instead, this policy must evolve as it adapts to changing conditions and to changing perceptions of the world. At the same time, it must embody a consistent set of principles that will guide future actions and ensure a stable environment for energy investments.

Beyond the import reductions due to decontrol of crude oil prices, the second National Energy Plan establishes a framework for making decisions about future energy needs and appropriate actions to encourage new supply development. Such efforts can lead to the ability to use "backstops" or substitutes that can reduce U.S. oil imports as world oil prices rise.

The specific initiatives in the President's program address those energy issues that are ripe for decision now. Though they will have benefits through 2000 and perhaps beyond, their greatest effect will occur over the next decade.

The oil import savings of the President's 1979 program--that is, decontrol of oil prices and use of the windfall profits to encourage shale oil and solar energy--depend on the alternatives to which they are compared as well as on the rate at which world oil prices will rise. In all circumstances, however, the President's program will have large positive benefits when compared with continued controls.

Table VIII-1 summarizes the estimated import savings from the President's program. Compared with an extension of current price controls, decontrol would reduce oil imports in 1985 by about 0.9 to 1.1 MMBD.

Most of the savings come from increased domestic production of conventional oil (about 740-840,000 barrels per day)--both through greater exploration for new sources and more intense development of existing fields. Some part of this increased exploration could enhance natural gas supplies as well. The rest of the savings (about 210-290,000 barrels per day) come from additional conservation induced higher oil prices. Over the longer term, oil decontrol becomes even more critical to reducing U.S. dependence on imports. The projected savings due to the decontrol and tax provisions increase in 1990 and later years when compared to continued controls.

TABLE VIII-1.
IMPORT REDUCTIONS FROM ACTIONS IN THE PRESIDENT'S PROGRAM[1]
(thousand barrels per day)

Proposed Action	1985	1990
Oil Decontrol and Tax[2]	950-1,130	1,400-2,100
Shale Oil Tax Credit	0-50	100-200
Solar Initiatives	50-70	100-140
Total Savings	1,000-1,250	1,700-2,300

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[1] Range of savings represents uncertainty due to world oil prices.

[2] Savings compared to a base case that assumes continued controls on domestic oil prices.

The President's program offers a $3 per barrel tax credit that would make shale oil production competitive with conventional oil under decontrolled prices. As world oil prices rise, however, shale oil would become economic even without the credit. The shale tax credit, therefore, would be phased out in stages. Under the President's proposal, the credit starts to diminish as world oil prices reach $20 per barrel, and disappears completely when world oil prices reach $23 per barrel.

With the long lead times required to commercialize shale oil production, the benefits of the shale oil credit will not be realized until 1985 and after. Beginning development of a viable shale oil industry now, however, offers greater protection later when world oil prices rise. If world oil prices remain low, the credit would stay in effect even longer, and would yield even greater import savings. The credit would stimulate an additional 100,000 to 200,000 barrels per day of domestic production by 1990. Ultimately, total shale oil production would be limited by environmental considerations.

The various solar energy tax credits that would be funded from the Energy Security Fund could reduce oil imports by an additional 200,000 to 300,000 barrels per day in 2000. These credits would be designed to stimulate greater use of passive solar in homes and new investments in solar equipment for industrial and agricultural process heat. The excise tax exemption for gasohol would be made permanent. Credits for wood-burning stoves and assistance for small hydro projects would also make a contribution. The savings realized from these credits would continue through the mid-term and beyond.

Table VIII-2 compares the oil import savings of the President's program, with those of two alternative cases: controls continued for an indefinite period and decontrol in 1981 without the windfall profits tax. When compared with continued controls, the President's program would yield oil import reductions that grow to 1.7 to 2.3 MMBD by 1990.

The oil import savings are less when the President's program is compared to decontrol in 1981. That option, however, would lead to a precipituous jolt to the economy in 1981, greater producer revenues without the tax, and would not provide a funding source to assist the poor, improve mass transit, and develop new energy technology. When compared with decontrol in 1981, the windfall profits tax diminishes production incentives in the latter part of the mid-term. Yet the revenues from the windfall profits tax would stimulate shale oil and solar energy. With increased production from these sources, the President's program is likely to have modest but positive advantages, even when compared to decontrol in 1981, during the early part of the mid-term. Only if

TABLE VIII-2

REDUCTIONS IN OIL IMPORTS DUE TO THE PRESIDENT'S PROGRAM[1]
(thousand barrels/day)

	1985	1990
President's Program Compared to Continued Controls	1,000 to 1,250	1,700 to 2,300
President's Program Compared to Decontrol in 1981 and No Other Initiatives	200 to 250	up to 350

prices rise rapidly and only toward the end of the century, does decontrol without the tax save more oil (about 200,000 barrels per day) than the President's program.

The President's program yields benefits through all three time periods. In the near-term, the import savings are due principally to the conservation, fuel-switching and increased oil production stimulated by the decontrol of oil prices. In the mid-term, the shale oil and solar tax credits begin to reduce import levels. In the long-term, the solar tax credits provide their greatest benefits.

Table VIII-3 shows projected U.S. energy consumption and production by fuel in 1985 and 2000 with the President's program. The combined impacts of the President's program and higher world oil prices tend to stabilize oil imports near current levels--around 8-9 MMBD in the mid-term.

B. The Second National Energy Plan and the Economy

The objective of the President's program is to improve the long-term health and security of the economy. By bringing U.S. oil prices up to world levels, the President's program will encourage more conservation and production, reduce balance of payments difficulties, and limit vulnerability to future world oil price increases. In the short run,

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[1] Range of savings represents uncertainty due to world oil prices.

Table VIII-3. ENERGY SUPPLY AND DEMAND WITH THE PRESIDENT'S PROGRAM[1]
Medium Price Case
(Quads per Year)

	1977	1985	2000
SUPPLY			
DOMESTIC PRODUCTION			
Crude Oil, NGL, and Shale Oil	20	22	21
Natural Gas	19	18	18
Coal [2]	14	20	36
Nuclear	3	6	16
Hydro, Solar & Geothermal [3]	4	6	10
TOTAL	60	72	100
IMPORTS			
Oil [4]	18	18	18
Gas	1	2	2
TOTAL[5]	19	20	20
TOTAL SUPPLY	78	92	119
CONSUMPTION			
END-USE CONSUMPTION			
Oil	33	34	35
Gas	17	19	22
Coal	4	5	9
Electricity	7	9	14
Solar & Other[4]	2	2	5
TOTAL	62	69	84
CONVERSION LOSSES	16	22	35
TOTAL CONSUMPTION	78	92	119

1/ Totals may not add due to rounding.

2/ Excludes coal exports.

3/ Includes 1.8 Quads of biomass not currently included in DOE statistics. Does not include prospective Presidential decisions on the Solar Domestic Policy Review.

4/ Net oil import estimates are 17 to 19 quads or 8 to 9 million barrels of oil per day. Imports are very sensitive to small changes in demand or supply.

5/ Net of refinery losses.

removal of oil price controls may increase inflation slightly and may dampen economic activity. In the long run, these effects would be more than offset by the gains in economic growth and efficiency.

It is essential to put in place now the policies that will best protect the Nation from the potential damage of future price increases. Chapter I described how high world oil prices would be likely to reduce economic activity and economic growth and contribute to inflation. In 1990, for example, the loss in output in the high world oil price case may be $64 to $110 billion when compared with the low price case--about 2 to 3.5 percent of total GNP. High oil prices would also increase the rate of U.S. inflation, perhaps by an additional half a percent a year from 1982 to 1995 in the high price case. Excessive oil imports would worsen the U.S. trade balance and generate downward pressure on the dollar, raising the price of U.S. imports and contributing to higher inflation.

In the context of these far greater economic dangers from high oil prices, the President's program has only the relatively minor effects on inflation and economic activity that are shown in Table VIII-4. The effects on inflation, economic growth, balance of trade, and employment from the President's program will be discussed briefly below. In the next section of this Chapter, the relationship of employment and energy policy will be discussed more generally.

Table VIII-4. ECONOMIC IMPACT OF PRESIDENT'S PROGRAM[1/]

	1979	1981	1983	1985
Inflation (Addition to the rate of change of the Consumer Price Index)	0.1	0.3	-0.1	*
Loss of Economic Output (Loss of GNP, Billions of 1972 Dollars)	0-0.3	1.3-1.9	1.9-3.8	0.9-1.2
Improvement in Foreign Trade Balance (Change in Billions of Current Dollars)	0.3	3.4-4.1	6.3-8.3	8.9-13.2

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* Less than 0.05

1/ Range of estimates reflects the uncertainty due to world oil prices

INFLATION

Currently, the average cost to U.S. refiners of both foreign and domestic oil combined is below the world oil price. The President's program would raise the price of oil gradually over the 28 months from June 1979 to October 1981. During that period, the U.S. rate of inflation may be slightly higher. For example, decontrol is likely to add about 5 to 7 cents to the price of a gallon of gasoline by the time it is completed in 1982. After the decontrol process is completed, however, the U.S. rate of inflation should be lower than it would have been without decontrol.

The actual inflationary effect of decontrol will depend on the behavior of world oil prices during the next three years. If future foreign oil prices rise with the rate of U.S. inflation, decontrol will result in a cumulative increase in the Consumer Price Index (CPI) of approximately 0.6 percent by 1983. If the foreign oil prices rise 3 percent faster than the U.S. inflation rate, decontrol will result in a cumulative increase in the CPI of 0.9 percent by 1983. As Table VIII-4 shows, the change in the rate of increase in the CPI in either case will be relatively small for any given year during the decontrol process.

In short, the contribution of decontrol to the overall U.S. rate of inflation is not large. At the same time, decontrol removes a hidden subsidy that encourages excessive imports of foreign oil, reduces high import bills and the resulting pressure on the dollar, and thereby eliminates a major potential source of future inflation.

ECONOMIC ACTIVITY

In the long run, the removal of price controls will increase the efficiency and output of the economy. Decontrol of oil prices raises national output by stimulating domestic energy production and reducing imports. The shift in U.S. oil demand from foreign to domestic producers means more economic activity in the U.S. In general, the President's program removes excess regulatory burdens and costs, promotes new domestic investment and improves the allocation of energy and other resources in the economy as a whole.

Table VIII-4 indicates that the short run losses in output from decontrol are extremely small. The cumulative loss in output by 1983 would not exceed 0.2 percent of the total GNP that the country would have reached without decontrol.

After 1983, the benefits from improved economic efficiency begin to outweigh the short run effects of the decontrol process and the U.S. economy is likely to grow at a rate faster than it would have without decontrol.

BALANCE OF TRADE

The reduction of oil imports improves the U.S. trade balance. Decontrol may result in an improvement in the trade balance of $1.4 to $1.6 billion in 1980, $3.4 to 4.1 billion in 1981, and $9 to $13 billion in 1985. The President's program will mean that the future growth of the oil import bill does not outpace the growth in U.S. economic activity. Accordingly, the U.S. will be better able to pay for imported oil through earnings from the expected growth in U.S. exports. The risks of dollar depreciation and a weaker U.S. currency will be diminished.

EMPLOYMENT

Similarly, the President's program has only minor and temporary negative impacts on employment. In the short run, decontrol will bring a slight increase in the unemployment rate, because it cuts overall demand and changes the mix of jobs available. Altogether, the Nation's unemployment rate could be about a tenth of a percent higher in 1981.

By 1985, the President's program will begin to lead to greater employment than would have occurred in the absence of decontrol.

Table VIII-5. NATIONAL EMPLOYMENT EFFECTS OF THE PRESIDENT'S PROGRAM

	Number of People Employed (Million)	Change from Base Projection	Change in Unemployment Rat
1979	95.6		
1981	102.9	-105,700	-0.1%
1985	111.5	+ 18,900	Negligible

The figures, however, do not reflect the job protection offered by the Nation's reduced exposure to oil supply interruptions. Disruptions of oil supplies, were they to occur, could cause temporary unemployment as industry was forced to reduce production. Disruptions would also create an environment of uncertainty in which businesses would be reluctant to make the investments necessary to ensure a growing economy and increased employment.

SUMMARY

The President's program has substantial long run economic benefits by reducing dependence on unstable foreign supplies and by stimulating greater domestic energy investments. It is a necessary set of measures to limit vulnerability to world oil supply and price uncertainties. Though the benefits will depend in part on how these uncertainties are resolved, they clearly will be more significant than the short run impacts of decontrol on inflation and economic activity.

C. Employment and Energy Policy

The second National Energy Plan has paid special attention to the relationships between employment and energy policy. The discussion above presented the aggregate employment impacts of the President's program, based on analysis using traditional, large-scale economic models. There is increasing concern that such models can not portray adequately the long-term employment effects of particular energy supply technologies and patterns of energy use. To illuminate these questions, the Department of Energy is expanding its research into the broader relationships among energy, total employment, labor productivity and the creation of new jobs. With new issues and questions identified, the answers needed for policy formulation can begin to emerge.

LONG-TERM EMPLOYMENT AND PRODUCTIVITY EFFECTS

As noted in Chapter I, the world energy problem can affect long-term U.S. economic growth adversely. But the reduction in economic growth from higher world oil prices will not necessarily reduce total U.S. employment below what could have occurred. Indeed, the rise in energy costs may prompt a substitution of labor for energy, increasing the total demand for labor and the number of jobs.

On the other hand, the productivity of labor would increase at a slower rate. With the substitution of labor for energy, each unit of labor input would account for a smaller share of economic output. Since labor productivity has a critical influence on wages of the American worker and the Nation's standard of living, a slow-down in labor productivity growth is hardly a benign development. Even so, real income and the standard of living should continue to grow in absolute terms in all the price cases. Better understanding of the relationships among rising energy costs, labor productivity and total employment will be critical in the design of future energy policies.

CREATING NEW JOBS

Recently, there has been great interest in the effcts of new energy sources and technologies on jobs and job-creation. A comprehensive analysis is still lacking; for new technologies in particular, there is little cost and job information. Nevertheless, new perspectives have begun to emerge that will guide further research.

First, most of the microeconomic analysis in this area has compared only the direct labor requirements of new developments with those of conventional energy systems. This type of analysis fails to consider the indirect employment effects--the jobs created in supporting industries that supply materials and services for energy systems. Second, such studies fail to take account of the jobs displaced when new systems actually replace conventional ones. Nor has there been adequate consideration of possible labor-saving production methods that normally are developed as promising new technologies, such as solar, move into mass production.

Finally, past research has failed to consider how the different capital and operating costs of various energy systems affect employment in non-energy sectors. If subsidized energy systems cost more per unit of energy output than alternatives, spending on such systems will be diverted unproductively from other sectors of the economy. That will slow growth and lower employment in these sectors.

It appears that the total impact of a new energy activity on total employment is intricately linked to the comparative cost of energy alternatives. To meet its long-term energy needs without compromising its full-employment goals, the Nation should accelerate efforts to make new technologies economic--and deploy those technologies on a large scale if and only if they are economic.

D. The Second National Energy Plan and Individuals

The ultimate goals of U.S. energy policy must be the security and well-being of individual Americans and their families. The human dimension of the energy problem sometimes is obscured by aggregate statistics on economic activity, inflation, or balance of trade. This section describes the impacts of the President's program on households and regions and includes additional analysis of the energy problems of low-income households and rural energy areas.

IMPACTS ON HOUSEHOLDS

U.S. consumers would experience increasing real costs for energy, particularly gasoline and home heating oil, even without decontrol. These increased costs would result from higher world oil prices and from physical decline of price-controlled lower-tier oil. Expenditures for gasoline and heating oil would continue to rise generally even without decontrol. As tables VIII-6 through VIII-9 indicate, the incremental costs of decontrol, when compared with continued controls, are relatively modest.

Gasoline prices would rise 5 to 7 cents per gallon at the pump. This would be equivalent to 4 cents per gallon in terms of today's purchasing power. In those same terms, the median U.S. household could expect to pay an additional $38 per year in 1981 for gasoline as a result of decontrol (Table VIII-6); those households which heat their homes with oil would pay an additional $29 annually for that oil (Table VIII-8).

When compared with continued controls, decontrol will increase the fraction of disposable income spent by the average household for fuel oil by less than two-tenths of a percent. See Table VIII-8. Decontrol will also increase the amount of disposable income spent for gasoline by about two-tenths of a percent.

Furthermore, there are only minor variations in the impacts in different regions. Tables VIII-6 and VIII-8 list the regional differences in expenditures for gasoline and heating oil.

Tables VIII-7 and VIII-9 depict the incremental costs of decontrol for households in different income brackets. These tables show that the incremental costs of decontrol, although minor, are relatively greater for households in the lower income brackets. Virtually any incremental energy cost increase can be painful for households with incomes below the poverty level. Though these costs may be small in absolute terms, special relief is appropriate. Otherwise, poor Americans would carry a disproportionate burden in the Nation's effort for greater energy security. Total incremental impacts of the President's program on the poor will be more than offset by the average payment of about $100 a year for relief of low-income households, as proposed in the President's program.

Table VIII-6. HOUSEHOLD EXPENDITURES FOR GASOLINE IN 1981, BY REGION

Median Expenditures (in 1978 dollars)

Region	Without Program	President's Program	Difference
New England	$733	$769	$36
New York/New Jersey	774	810	36
Mid-Atlantic	742	779	37
South Atlantic	740	777	37
Midwest	797	837	40
Southwest	733	771	38
Central	747	785	38
North Central	749	788	39
West	775	812	37
Northwest	784	823	39
U. S. Average	761	799	38

Expenditures as a Percent of Median Household Disposable Income

Region	Without Program	President's Program	Difference
New England	4.0%	4.2%	0.2%
New York/New Jersey	3.9	4.1	0.2
Mid-Atlantic	4.4	4.6	0.2
South Atlantic	5.4	5.6	0.2
Midwest	4.5	4.7	0.2
Southwest	5.3	5.6	0.3
Central	5.2	5.5	0.3
North Central	5.2	5.4	0.2
West	4.7	4.9	0.2
Northwest	4.9	5.1	0.2
U. S. Average	4.7	4.9	0.2

Source: Expenditure and income data are from the Energy Information Administration MATH/CHRDS model and prices used are from the MEFS model. Medians are for households with positive incomes and energy expenditures. (Tables VIII-6 through VIII-11).

Table VIII-7. HOUSEHOLD EXPENDITURES FOR GASOLINE IN 1981, BY INCOME GROUP

Median Expenditures (in 1978 dollars)

Income Group	Without Program	President's Program	Difference
Below Poverty Level 1/	$ 457	$ 480	$ 23
Under $5,000	387	406	19
$ 5,000 - $ 9,999	532	559	27
$10,000 - $14,999	672	706	34
$15,000 - $19,999	824	865	41
$20,000 - $24,999	888	932	44
$25,000 - $29,999	1,032	1,084	52
$30,000 - $34,999	1,137	1,194	57
$35,000 and Over	1,170	1,229	59
U. S. Average	761	799	38

Expenditures as a Percent of Median Household Disposable Income

Income Group	Without Program	President's Program	Difference 2/
Below Poverty Level 1/	15.9%	16.7%	0.8%
Under $5,000	11.5	12.1	0.6
$ 5,000 - $ 9,999	7.0	7.3	0.3
$10,000 - $14,999	5.4	5.6	0.3
$15,000 - $19,999	4.7	4.9	0.2
$20,000 - $24,999	4.0	4.2	0.2
$25,000 - $29,999	3.8	4.0	0.2
$30,000 - $34,999	3.6	3.7	0.2
$35,000 and Over	2.7	2.9	0.2
U. S. Average	4.7	4.9	0.2

1/ Poverty status varies with size of household.
2/ Differences between columns do not add due to rounding.

Table VIII-8. HOUSEHOLD EXPENDITURES FOR HOME HEATING OIL IN 1981, BY REGION

Median Expenditures (in 1978 dollars)

Region	Without Program	President's Program	Difference
New England	$446	$479	$33
New York/New Jersey	443	474	31
Mid-Atlantic	399	426	27
South Atlantic	283	302	19
Midwest	401	432	31
Southwest	184	197	13
Central	391	422	31
North Central	359	386	27
West	320	343	23
Northwest	351	376	25
U. S. Average	401	430	29

Expenditures as a Percent of Median Household Disposable Income

Region	Without Program	President's Program	Difference *
New England	2.8%	3.0%	0.2%
New York/New Jersey	2.8	3.0	0.2
Mid-Atlantic	2.8	3.0	0.2
South Atlantic	2.4	2.5	0.2
Midwest	2.6	2.8	0.2
Southwest	1.8	1.9	0.1
Central	3.9	4.3	0.3
North Central	4.0	4.3	0.3
West	2.4	2.5	0.2
Northwest	2.4	2.6	0.2
U. S. Average	2.7	2.9	0.2

* Differences between columns do not add due to rounding.

Table VIII-9. HOUSEHOLD EXPENDITURES FOR HOME HEATING OIL IN 1981 BY INCOME GROUP

Median Expenditures (in 1978 dollars)

Income Group	Without Program	President's Program	Difference
Below Poverty Level 1/	$353	$379	$26
Under $5,000	366	392	26
$ 5,000 - $ 9,999	376	403	27
$10,000 - $14,999	390	418	28
$15,000 - $19,999	404	433	29
$20,000 - $24,999	418	448	30
$25,000 - $29,999	435	466	31
$30,000 - $34,999	468	502	34
$35,000 and Over	455	487	32
U. S. Average	401	430	29

Expenditures as a Percent of Median Disposable Income

Income Group	Without Program	President's Program	Difference 2/
Below Poverty Level 1/	12.9%	13.8%	0.9%
Under $5,000	11.0	11.8	0.8
$ 5,000 - $ 9,999	5.0	5.4	0.4
$10,000 - $14,999	3.1	3.3	0.2
$15,000 - $19,999	2.3	2.5	0.2
$20,000 - $24,999	1.9	2.0	0.1
$25,000 - $29,999	1.6	1.7	0.1
$30,000 - $34,999	1.5	1.6	0.1
$35,000 and Over	1.1	1.1	0.1
U. S. Average	2.7	2.9	0.2

1/ Poverty status varies with size of household.
2/ Differences between columns do not add due to rounding.

REGIONAL ENERGY COSTS AND INDUSTRY LOCATION

Though decontrol does not have significantly different impacts on households in any region, current differences in regional energy prices are likely to persist over the next 15 to 20 years in all world oil price cases. These price variations arise in part from the difference in transportation costs of delivered fuels as well as the different mix of fuels and environmental constraints on fuel use in various regions.

Variations in regional energy prices have some limited influence on the location of industry and business. It should be emphasized, however, that energy costs represent only about four percent of manufacturing costs on average. By themselves, apart from other factors, regional energy prices would not appear to determine directly the location decisions of most industries.

At least with respect to oil, regional price differences due to transportation may become less significant as world oil prices rise. Transportation costs would account for a declining portion of delivered fuel oil prices. In addition, the elimination of the distinction between the price-controlled interstate and the intrastate markets for natural gas--and the incremental pricing provisions for new gas supplies--may reduce the regional advantages enjoyed by certain industrial gas users. As a result, though regional differences in energy costs will continue, some movement toward parity seems likely.

RURAL ENERGY EXPENDITURES

Rural areas of the U.S. are especially sensitive to energy price changes for a variety of reasons. First, rural residents have somewhat lower average incomes than urban residents. As Table VIII-10 and VIII-11 show, the rural household spends more of its smaller disposable income on gasolines and heating oil. Though incremental impacts of decontrol are quite modest in rural as in urban areas, a greater proportion of rural residents will qualify for special relief from the Energy Security Fund. In this respect, the rural areas will benefit relative to urban areas as a result of the President's program.

Second, rural residents drive long distances and have fewer alternatives, if any, to automobile travel. When gasoline prices rise, therefore, it is difficult to cut back on short trips, as urban residents can, or to take the bus.

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Table VIII-10. HOUSEHOLD EXPENDITURES FOR GASOLINE IN 1981, IN URBAN AND RURAL AREAS

Median Expenditures (in 1978 dollars)

	Without Program	President's Program	Difference
Urban	$759	$797	$38
Rural [1]	776	815	39
Other [2]	754	792	38
Total U.S.	761	799	38

Expenditures as a Percent of Median Disposable Income

	Without Program	President's Program	Difference [3]
Urban	4.4%	4.7%	0.2%
Rural	5.8	6.1	0.3
Other	4.9	5.2	0.2
Total U.S.	4.7	4.9	0.2

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[1] "Rural" is defined to include (1) areas outside standard metropolitan statistical areas and (2) areas within standard metropolitan statistical areas which are unincorporated or are specified by the Bureau of the Census, Department of Commerce, as rural areas.

[2] Rural/urban location is not available for households in several states because of confidentiality requirement peculiar to the data base used.

[3] Differences between columns do not add due to rounding.

Table VIII-11. HOUSEHOLD EXPENDITURES FOR HOME HEATING OIL IN 1981, IN URBAN AND RURAL AREAS

Median Expenditures (in 1978 dollars)

	Without Program	President's Program	Difference
Urban	$408	$437	$29
Rural*	371	398	27
Other**	415	445	30
Total U.S.	401	430	29

Expenditures as a Percent of Median Household Disposable Income

	Without Program	President's Program	Difference
Urban	2.7%	2.9%	0.2%
Rural	2.7	2.9	0.2
Other	2.9	3.1	0.2
Total U.S.	2.7	2.9	0.2

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*"Rural" is defined to include (1) areas outside standard metropolitan statistical areas and (2) areas within standard metropolitan statistical areas which are unincorporated or are specified by the Bureau of the Census, Department of Commerce, as rural areas.

**Rural/urban location is not available for households in several states because of confidentiality requirement peculiar to the data base used.

Third, the business of agriculture has become more and more energy-intensive through the present century. Direct farm use of energy has increased to about 2 quads annually. Consumption of agricultural chemicals--the manufacture of which requires large quantities of natural gas--has increased five-fold in the past 25 years. Recent analyses have shown that it takes 7 to 10 times more energy to produce, process, deliver, and serve a single calorie of food today than it did in 1910. The total amount of energy used to produce, transport, process and cook food in the country now amounts to 11-12 quads annually--or about 16 percent of total U.S. energy use.

The NEA recognized the importance of assuring adequate supplies of energy to the agricultural sector. For example, it provides a high priority for gas uses related to farming -- such as fertilizer production. Earlier laws ensure high priority for agriculture-related uses in any emergency petroleum allocation system.

Rural areas could benefit from the emphasis on solar energy development. The Department of Energy is sponsoring research on a wide range of solar technologies -- some of them, such as modern approaches to solar crop-drying and solar-powered irrigation pumps, specifically to increase the use of solar energy on the farm. These efforts could yield great advantages for rural areas, since the agricultural use of energy will increase with the decline in farm employment.

Finally, the productivity of agriculture has a broader and critical role in the nation's energy strategy. Last year, agricultural exports, valued at $28 billion, accounted for nearly 20 percent of all U.S. exports. Net agricultural exports thereby offset nearly one-third of the Nation's oil import bill. With such exports, the U.S. will remain less vulnerable to economic damage from rising world oil prices.

E. The Second National Energy Plan and Capital Markets

Private capital markets should be able to meet the anticipated demands for investment in energy production and conservation--including the additional investment demands that will be stimulated by the President's program.

Although the amount of capital available for energy investment should be adequate to 1990, there will be cyclical periods of tight monetary and financial conditions. Furthermore, the Federal government may wish to accelerate development of certain forms of energy production that carry high financial risks. In such cases, where the risks to the private sector are high but the national interest in the specific project is great, Federal loan guarantees or other innovative financial mechanisms may be appropriate.

Table VIII-12 shows the investment requirements of the energy sector in the medium world oil price case. The investment requirements of the energy sector will grow approximately 1 percent per year between 1978 and 1990. This rate of growth is sharply below the previous growth rate of 5.5 percent a year for energy investments from 1966 to 1976. The decline in projected growth occurs for two reasons--the slower growth in future U.S. energy demand and the leveling-off of the increased capital spending for energy which occurred after the 1973-74 price rise.

To determine the ability of the economy to meet the future investment requirements of the energy sector, Table VIII-12 compares total energy sector capital requirements with projections of total U.S. non-residential fixed investment under different assumptions for monetary conditions.

In the "normal" case, the energy sector would account for 19 percent of U.S. investment in 1990. Monetary restraint due to high inflation would reduce the total amount of U.S. fixed business investment, and increase the proportion of U.S. investment (though not the absolute amount) that the energy sector will require. If money were extremely tight, the energy sector would account for 22 percent of the reduced total of U.S. business investment in 1990.

In the past, capital investment in the energy sector has ranged from 16 percent (in 1965) to 31 percent (in 1977) of total non-residential investment. The shares of total investment projected here are well within these past ranges. In both cases, the share of U.S. investment required by energy development drops to the low end of the historic range, chiefly because electric utility demand, which will be below historic growth rates, dominates capital expenditures. Though fixed business investment accounts for an increasing share of real GNP, the investment needed in the energy sector may account for a decreasing share of GNP.

Of the energy industries, electric utilities will rely most heavily on external financing. In fact, electric utilities will constitute the largest single industrial user of credit in the U.S. economy. Their credit needs will be great, even if below those once anticipated. Electricity use in the mid-term is expected to increase at a rate faster than any other fuel source, though at about half the rate of some earlier forecasts.

Some of the new synthetic fuel projects, such as those for high-Btu coal gasification, may require innovative financing mechanisms. Special regulatory consideration and loan guarantees may be necessary to demonstrate their technical and economic feasibility. Other projects, such as enhanced oil recovery, can be financed through special regulatory incentives.

Table VIII-12

CAPITAL INVESTMENT NEEDS OF THE ENERGY SECTOR

(Billion 1978 dollars)

		Non-Residential Business Fixed Investment			
	Total Capital Expenditures for Energy1/	"Normal" Monetary Case	Energy as Percent of Total	"Tight" Monetary Case	Energy as Percent of Total
1977 2/	$63.3	$206.0	31%	$206.0	31%
1978 2/	59.6	222.0	27%	222.0	27%
1979	57.5	230.1	25%	230.3	25%
1980	56.7	231.2	25%	231.5	25%
1981	55.2	243.8	23%	244.2	23%
1982	56.6	250.7	23%	249.8	23%
1983	59.7	261.4	23%	250.9	24%
1984	61.0	276.5	22%	263.6	23%
1985	63.0	289.8	22%	278.8	23%
1986	65.2	302.3	22%	288.5	23%
1987	67.2	315.2	21%	296.9	23%
1988	67.8	327.9	21%	302.6	22%
1989	66.9	340.1	20%	298.5	22%
1990	67.2	352.0	19%	305.8	22%
Cummulative Requirements, 1979-1990	744.0	3421.0		3241.4	

1/ Assuming medium world oil prices and implementation of the President's Program.

2/ Actual

Solar technologies and new conservation measures will also be large users of capital over the next 20 years. Indeed, the capital needs projected in Table VIII-12 presume a greater amount of new investment in energy conservation, not all of which is reflected in the projections.

The ability of consumers to finance investments in solar energy and conservation becomes important. The tax credits in the NEA and the President's program should stimulate residential conservation and solar use. The NEA also provides a loan guarantee program for conservation improvements by the elderly and by moderate income families.

F., The Second National Energy Plan and the Environment

The environmental impacts of new initiatives in the President's program for 1979 will be relatively limited, when compared with the larger environmental trends likely in the Nation's energy future. Decontrol of oil prices will restrain the overall use of oil, and will substitute more domestic production for imported oil. Development of a viable shale oil industry will have regional environmental impacts, as described in separate environmental analyses that will be made available shortly. This section highlights the results of those analyses: first, with respect to environmental trends generally, and then the specific environmental impacts associated with the President's program.

ENVIRONMENTAL IMPACTS OF FUTURE ENERGY USE

The growth in energy use and in economic activity generally will pose increasing challenges to the Nation's commitment to preserve and enhance the quality of its environment.

The increased reliance in the mid-term on coal and nuclear power as the main transition fuels will present more environmental challenges and uncertainties than the current energy supply system. If most future energy demand growth is to be met with coal and nuclear power, the Nation will have to make a more intensive, concerted effort to resolve the environmental problems attending use of these fuels.

Some synthetic fuels, such as oil shale and coal liquids and gases, are expected to become economically attractive during the 1990s. The air pollution impacts from these technologies can be controlled. Shale oil consumes large quantities of water for processing, disposal, and revegetation. Mining, processing and disposal of shale may also contaminate water supplies. A particularly important problem with shale is finding suitable ways of disposing of massive quantities of spent shale from which the oil has been recovered. Coal-based synthetics require increased coal mining and production and can result in release of toxic substances within and outside the plant. Since commercial-sized plants have not yet been built, actual environmental effects are still somewhat uncertain. However, environmental research is being conducted to develop the required information on which appropriate standards and controls can be based, in order to protect public health and welfare.

The major unresolved technical problem of nuclear energy is the disposal of high-level radioactive wastes. Siting and operation of nuclear plants must be done with care because of concerns associated with radiation safety.

In comparison to conventional fuels, solar energy is relatively benign from an environmental standpoint. However, some solar processes, such as biomass and solar-thermal electric with once-through cooling, could consume significant amounts of water and require use of large land areas. Also, combustion of biomass adds carbon dioxide to the atmosphere.

The U.S. will have to monitor carefully the environmental effects of energy development and intensify its search for environmentally acceptable solutions. The major pieces of energy legislation enacted in this decade have all emphasized that environmental protection should be integral to energy policy. The second National Energy Plan carries forward this continuing national commitment. In the next section, the environmental trends in a number of specific areas are briefly described.

FUTURE ENVIRONMENTAL TRENDS*

Air Emissions. Stricter emission controls will most likely be implemented prior to 1985 as a consequence of the Clean Air Amendments of 1977. As a result, emissions of three air pollutants of concern (particulates, hydrocarbons and carbon monoxide) are projected to decrease between 1975 and 2000. Upgrading particulate controls on existing and future coal-fired facilities will decrease particulate emissions from electric utilities and industrial boilers sharply through 2000. Sulfur oxide emissions in 2000 are expected to be about the same or slightly less than they were in 1975. Increases in SO_2 from coal combustion would be counteracted by improved efficiency in emmission control devices. Total nitrogen oxide emissions are expected to increase about 32 percent between 1975 and 2000. In certain regions, non-attainment of air quality standards, or regulations prohibiting significant deterioration of air quality, may restrict energy development.

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* Environmental trends and impacts are based on analysis contained in a separate environmental report which accompanies this document. Changes are with respect to conditions in the 1975 base year.

A major long-term concern associated with the combustion of fossil fuels generally is the effect of increased carbon dioxide in the atmosphere. Since 1850, the amount of carbon dioxide (CO_2) in the atmosphere has increased approximately ten percent. A fourth of this increase has occurred within the past ten years. The trend is significant enough that a two-or three-fold increase of carbon dioxide levels in the next 100 years is conceivable. Current models predict a 2^o to 3^oC increase in average surface temperature for each doubling of the carbon dioxide level. While neither the effects of an increase in carbon dioxide on the climate, nor the effects of a related climate change on the environment, are yet well understood, the conceivable impacts are sufficiently troublesome to warrant extensive investigation. The Department of Energy is leading national efforts better to understand the CO_2 problem.

Water Consumption. The Nation's energy industry is expected to almost quadruple its consumption of water between 1975 and 2000. The general growth in electricity generation and particularly the greater use of nuclear power for electricity will account for the majority of this increase. A number of areas in the West might face water shortages in the future. Such shortages could limit the growth of some forms of energy production in those areas.

Water Pollutant Discharge. National efforts during the last decade are beginning to improve water quality. Nevertheless, water pollution remains a widespread problem. Energy, particularly electric utilities and coal mining and processing operations, would be responsible for a substantial share of point source releases of total dissolved solids, oil and greases, and sulfates to the Nation's waterways. Energy industries make only minor contributions to most other water pollutants. Total dissolved solids double from 1975 to 2000. Total suspended solids and chlorides from energy sources are projected to decrease slightly over the projection period. Nutrients and biological energy demand from energy sources are projected to stay at about their 1975 levels.

Solid Waste. Non-combustible solids remaining after conversion of solid fuels and sludges from energy-related pollution control devices currently account for about 17 percent of all solid waste produced in the U.S. By 2000, such wastes would increase several-fold as a consequence of greater coal use, posing challenges of dealing with larger landfill volumes, leaching and transport of undesirable contaminants, and disposal of hazardous wastes.

Radioactive Pollutants. The electrical generating capacity of nuclear power plants has been projected to increase three to six-fold from 1975 to the end of the century. Nuclear utilities produce three types of radioactive waste: solid waste such as spent fuel and reactor parts;

liquid waste containing low levels of pollutants from nuclear plant cooling; and reactor off-gases. The combustion of coal and oil may also produce radioactive pollutants, but to a much lesser degree than nuclear processes. Radionuclide emissions in 2000 may increase up to nine times 1975 levels. However, the potential level of exposure to the public from these emissions would still be far below that from natural sources, medical sources, and other technology-caused emissions (e.g., aircraft travel). One of the most important concerns, the disposal of high-level radioactive solid wastes, is being addressed through the long-term strategy discussed in chapter VI.

The U.S. need not make premature decisions on the use of new technologies, as long as further information about their environmental and health characteristics, as well as technical and economic feasibility, proceeds along with development of the technologies. By developing a number of technology and resource options, the Nation would have the flexibility to turn to alternatives if one or more supply options proved unacceptably hazardous.

ENVIRONMENTAL IMPACTS OF THE PRESIDENT'S PROGRAM

Phased decontrol of crude oil prices is anticipated to result in the largest change in energy use and potentially the greatest impact on the environment. Analysis contained in the separate environmental report will show that the environmental effect of this initiative is small; other initiatives can be expected to exhibit even smaller impacts.

Acceleration of the development of shale oil through the shale oil tax credit would accelerate the onset of the environmental impacts associated with such development, although the ultimate level of shale production, and thus the ultimate environmental impacts, would be unchanged. The overall effect of the solar initiatives on the environment is likely to be benign.

Many of the conservation initiatives are expected to result in readily quantifiable local and regional savings in oil use and in concomitant environmental effects. The last group of initiatives represents administrative actions that do no lend themselves readily to quantification.

The initiatives include existing programs in the Department of Energy and other Federal agencies, as well as new proposals that would be undertaken by Federal or State governments. Several National Environmental Policy Act (NEPA) environmental assessments or Environmental Impact Statements (EISs) have been, or are being, prepared. The status of the NEPA documents are summarized in the accompanying report.

G. Conclusion

The second National Energy Plan places strong emphasis on the uncertainties in the Nation's energy future--geologic, economic, political, technological, environmental and institutional. It calls for policies that can anticipate these uncertainties, and if possible, reduce them through actions that will buy insurance against future world oil price increases.

No single set of measures can eliminate these uncertainties; nor can any single set of measures bring large and immediate reductions in U.S. oil imports. Instead, over the foreseeable future, the U.S. must learn to live with relatively high imports and continued supply uncertainties. It can exercise some constraining influence on future world oil price increases, but it cannot by itself hold back the underlying forces leading to a world of higher-cost energy.

Despite these limits, a formidable agenda for action awaits the Nation over the next decade. The new pricing policies in the President's program will be essential to increase conservation and to stimulate new supply development. The government's role in regulating the energy efficiency of cars, appliances, and buildings will be critical. Technological innovation and more efficient energy designs must be stimulated to lower the long-term growth in U.S. energy demand.

The Nation must also attempt to identify future energy supply needs, and design policy actions that can stimulate maximum supply at least cost. In general, the Plan expects the private capital markets will meet future investment needs in the energy sector without placing special burdens on the consumer or the taxpayer.

The Nation must search out options to solve its energy problems with minimum environmental impact. Conservation and solar energy offer ways of meeting energy needs without environmental disruption. Cost-effective use of solar technologies and conservation should be pursued as a high national priority.

Above all, the Nation must integrate its foreign and economic policies with the new energy realities. Since import dependence through the year 2000 is inevitable, the U.S. must develop strategies to diversify its sources of foreign supply. It must be vigilant to take those steps, small and large, that will enhance its political security as well as economic strength.

Government cannot avoid responsibility for managing a careful transition to new and changing energy realities. The security of the Nation during that transition cannot be entrusted altogether to the impersonal operations of cartels and artificial markets. Actions are necessary to reduce the risk of shocks--both economic and political--which have unsettled the Nation so greatly in the past half-decade.

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DOE/IR-0048

U.S. Department of Energy

RESPONSE PLAN:
REDUCING U.S IMPACT ON THE WORLD OIL MARKET

April 1979

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SUMMARY OF RESPONSE PLAN:
REDUCING U.S. IMPACT ON THE WORLD OIL MARKET

The Need to Reduce U.S. Petroleum Use

The U.S. has entered into a commitment with the International Energy Agency (IEA) to reduce petroleum consumption by up to 5 percent as its contribution to offset the world's shortfall brought about by reduced oil production in Iran. The 20 member countries of the IEA entered into this joint agreement to prevent shortfalls and to stabilize the world oil market and reduce pressures for premium oil prices. The U.S. obligation under this agreement is to reduce demand for oil imports by up to 1 million barrels per day (MMB/D) by the end of 1979. The President set forth the specific measures to meet that commitment in his speech of April 5, 1979.

Since December, world oil reductions from the termination of Iranian exports have resulted in a total shortfall of about 200 million barrels (MMB). Although Iran has now resumed oil exports at less than 2.5 MMB/D, its foreign sales are more than 2.5 MMB/D below its export level in 1978. Conditions in Iran remain uncertain, and it would not be prudent to depend heavily on continued exports from Iran at even the current low level.

As Iran's oil exports ended last December, other major exporting countries increased production to offset about 3 MMB/D of the 5 MMB/D shortfall. Continuation of this higher level of production cannot be relied upon. Saudi Arabia and other Arab producers, which contributed most of the surge production, have indicated an intent to cut back production as Iranian exports resume, and Saudi Arabia is in the process of cutting back production by about 1 MMB/D. Reduced production will keep supplies tight and support the higher price levels announced by OPEC on March 27, particularly high premiums for light crudes.

The IEA commitment will ease the interim oil supply problem faced by the U.S. as a result of the reduced oil production by Iran. Imports to the U.S. in the first quarter were about 700,000 barrels per day (B/D) less than needed to maintain stocks at desired levels. The loss of crude oil imports resulted in reduced refinery output; refinery utilization rates have dropped from 91 percent last December to 88 percent in January, 84.5 percent in February, and 83.5 percent in March. The shortfalls in refinery output and imports have required excess use of petroleum stocks to meet demand. As a result, industry oil stocks are about 70 million barrels (MMB) below projected normal levels.

Distillate fuel oil stocks are at an unacceptably low level, and it is critical that these stocks be rebuilt to safe levels before the next heating season. Gasoline stocks also have been drawn down faster than desired and are now below projected normal levels going into the summer peak demand period. Unless petroleum demand is restrained, heating oil stocks would not be built to safe levels by next fall. If distillate fuel oil demand is not reduced, fuel oil stocks for next winter must be built by reducing gasoline production. If demand for gasoline stays at current high levels (4.5 percent above the 1978 demand) there would be substantial shortfalls before the summer is over. The shortfall of gasoline would be due to the reduced stocks and the reduced refinery throughput, as well as the heavier crude oil substituted for Iranian oil, which reduces gasoline production capability.

In addition to the IEA goal to reduce U.S. oil demand, two oil supply shortfall scenarios were considered in developing the U.S. Response Plan. The Base Case scenario assumes a world supply shortfall of about 1 MMB/D due to the need to rebuild inventories, difficulties in sustaining production in Iran, and/or reductions of supply by other producers. The More Severe scenario assumes a return to the more serious 2 MMB/D world oil shortfall experienced earlier this year. Under the Base Case, oil shortfalls in the United States would be about 700,000 barrels per day between now and October, reflecting the high demand to rebuild stocks and the limited level of imports. Shortfalls beyond October would be about 500,000 barrels per day. If the world oil shortfall increases to 2 MMB/D, the shortfalls in the United States could increase to about 1.1 MMB/D in the third quarter, reflecting the high demand for stock rebuilding, and to about 900,000 barrels per day in the fourth quarter of 1979 and the first quarter of 1980.

Chart A shows the estimated oil shortfalls under the two scenarios. Charts B and C show the impact of these shortfalls on U.S. supplies of gasoline and distillate fuel oil if consumption is not reduced.

Potential Oil Shortfalls

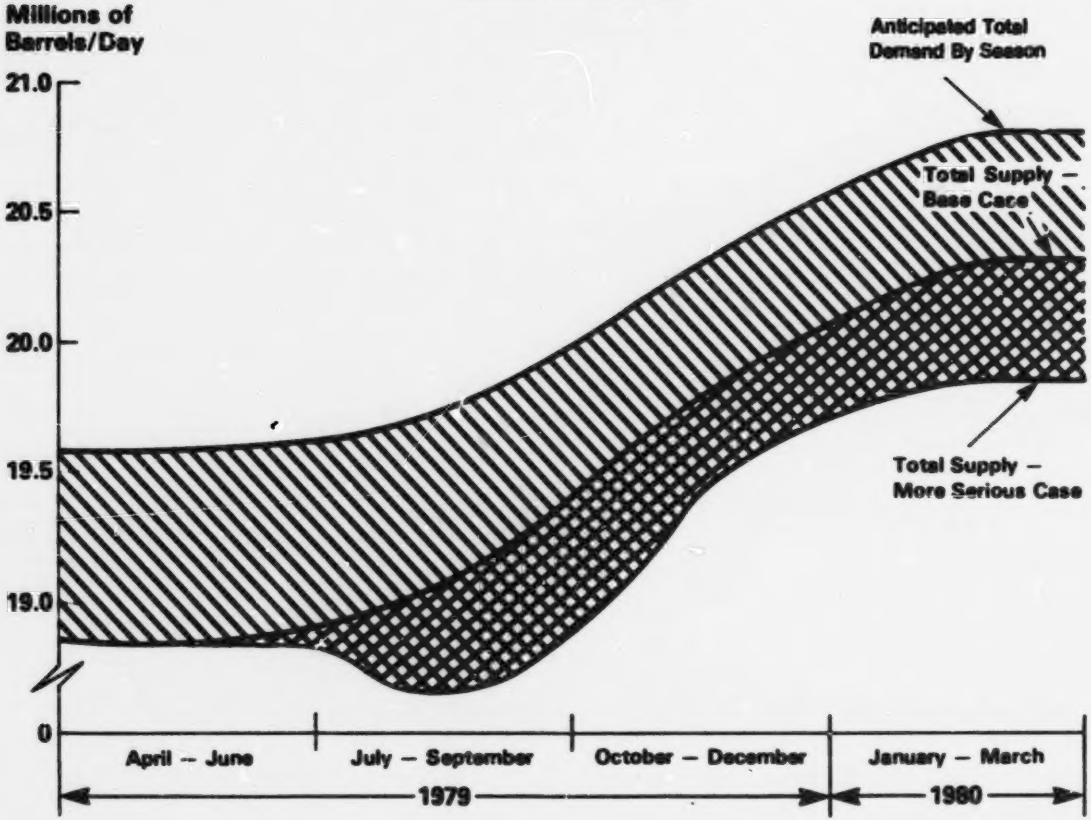
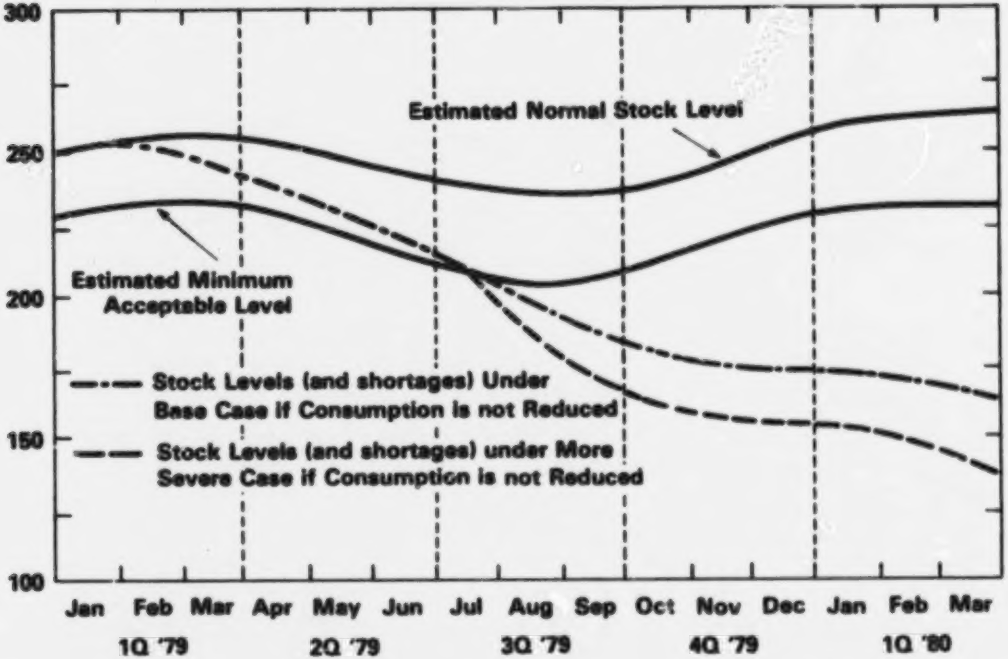


CHART A

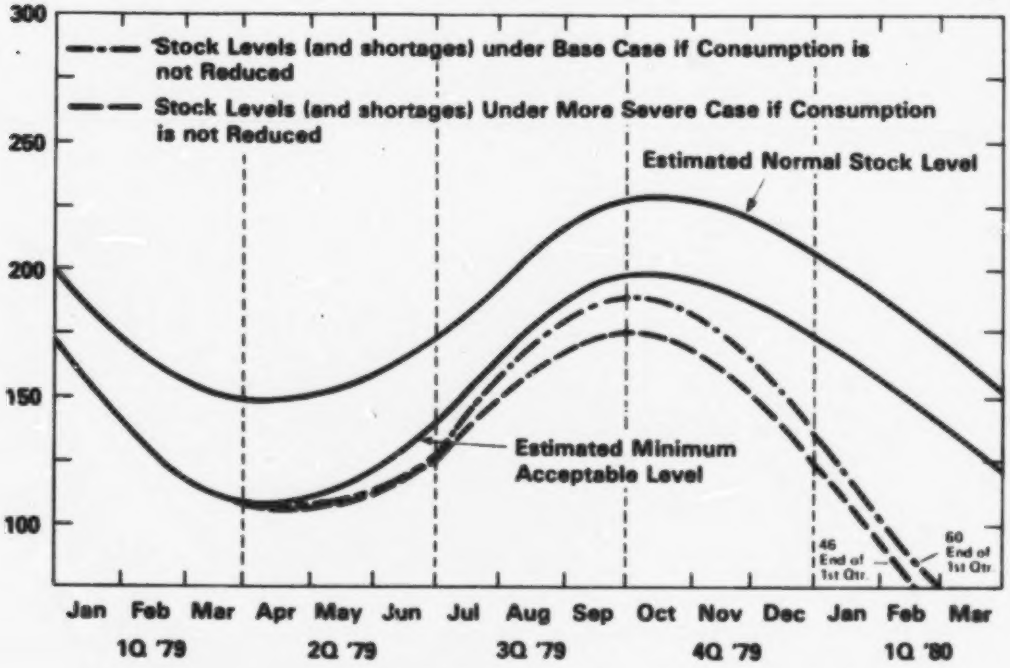
Gasoline Stocks at Primary Level
(Millions of Barrels)



The stock levels below the Estimated Minimum Acceptable Level are hypothetical since stocks would actually be maintained at minimum levels through curtailments in supply.

CHART 8

Distillate Stocks at Primary Level
(Millions of Barrels)



The stock levels below the Estimated Minimum Acceptable Level are hypothetical since stocks would actually be maintained at minimum levels through curtailments in supply.

CHART C

A failure to reduce world oil consumption will result in further increases in foreign oil prices as refiners bid for the limited supplies. "Premium" prices for foreign oil may be bid significantly above the new high base price established by OPEC. Effective action by the IEA member countries to reduce consumption will help to stabilize market conditions and discourage further price increases.

Proposed Response Plan

The Response Plan is designed to meet the IEA commitment to reduce oil demand, to minimize pressures on world prices and avoid oil supply problems later in the year.

The Response Plan contains a graduated set of measures to be implemented as necessary to meet the IEA commitment and to deal with potentially more severe shortfalls. The plan provides for:

- Early implementation of a number of measures to reduce consumption, increase domestic production, assure equitable distribution of available crude oil and provide for rebuilding distillate fuel oil stocks to safe levels. The measures selected for immediate implementation are those which will have little or no adverse economic impacts.
- If the initial actions are not sufficient, more severe measures would be introduced to reduce consumption further, to require the build up of distillate stocks to acceptable levels, and to distribute available oil supplies equitably.

The Response Plan is designed to rebuild winter fuel oil stocks to safe levels by next October. Petroleum stocks have already been reduced by about 70 million barrels below normal by the end of March. It will be necessary to rebuild distillate stocks to safe levels by October to assure adequate heating oil supplies for the winter heating season.

Refiners will be requested to take action to build distillate stocks to target levels by October, so that total U.S. distillate stocks reach at least 240 MMB. If necessary, regulatory actions will be used to assure safe distillate fuel oil stock levels.

A wide range of crude and product allocation procedures are available to help resolve any severe distribution problems that may occur. Some allocation of crude oil will be necessary to provide equitable allocation of the reduced crude supply among refiners. It also may be necessary to establish an allocation fraction to allocate gasoline and possibly other products among users. Allocation may be on a voluntary industry-wide basis, with standby mandatory allocation to be used if necessary.

Specific Response Measures

Table A summarizes the response measures and reduction targets needed to meet the IEA goal.

The immediate response measures include the following:

- Each State has been urged by the President to implement plans to reduce gasoline consumption. The President will set targets for reductions in gasoline use. If successful, this effort will avoid the need for mandatory Federal plans to inhibit gasoline demand.
- State governments also have been requested by the President to reduce their direct use of gasoline, and to control government building temperatures, similar to the requirements placed on Federal agencies.
- All Americans have been requested to reduce their total oil consumption by actions such as reducing discretionary driving, use of carpooling and mass transit, obeying speed limits, and setting their home and office thermostats at 65 degrees in the heating season and 80 degrees in the cooling season. All drivers have been requested by the President to reduce driving by 15 miles per week.

- In the Federal sector, the President has directed Federal agencies to take immediate steps to reduce energy use by at least 5 percent. As part of this reduction, all agencies are being required to reduce use of gasoline for government vehicles by 10 percent, and control building temperatures at no warmer than 65 degrees in the winter and no cooler than 80 degrees in the summer. To encourage Federal employees to use carpools or mass transit, Federal employees will be required to pay full commercial rates for parking spaces provided by the agencies in urban areas. The full rates will be phased in starting in October.

- The effort started in January to switch large utility, industrial and commercial users from oil to natural gas is continuing. There is a large potential for switching from oil to natural gas, particularly in the summer of 1979, which could offset a substantial portion of the shortfall. Oil savings from this effort had reached over 200,000 B/D by early April.

- Electric utilities are being encouraged to transfer excess electricity from coal and hydro power plants to utility systems which rely on oil fired plants to reduce the need to use oil.

- Mandatory building temperature controls will be implemented upon approval of the plan by Congress. The plan would require thermostats to be set at no warmer than 65° in the winter and no cooler than 80° in the summer in public, commercial and industrial buildings.

- To increase gasoline supplies, and reduce fuel used for oil refining, EPA is modifying its current requirements for the phasedown of lead in gasoline.

- The President will consider State requests for waivers of State standards under the Clean Air Act if this is found to be appropriate due to shortages of low sulfur fuel oil. The Administrator of EPA will consider unusually large increases in the price differential between complying and non-complying fuels as a basis for recommending approval of State requests.

- Refiners will be requested to establish targets to rebuild distillate fuel oil stocks to acceptable levels by next October. DOE will be prepared to implement additional measures, including voluntary or mandatory gasoline allocation fractions, if the voluntary stock building effort is insufficient.

- The shortages of crude oil may require allocation of crude among refiners to avoid severe inequities. As smaller refiners have serious crude shortages, DOE will continue to direct larger refiners to sell crude oil to the small refiners under the current Buy/Sell program. If serious inequities develop for larger refiners, a range of actions can be taken, including using the current Buy/Sell program, establishing a separate Buy/Sell program for larger refiners, or implementing the full crude oil allocation program to allocate oil to all refiners based on a fraction of pre-interruption oil supplies.

In addition to the above demand reduction measures, the following actions are now underway to increase domestic oil production and restrain oil demand to help reduce the oil shortage by late 1979 and early 1980:

- The planned decontrol of crude oil prices will reduce demand for oil and stimulate greater domestic oil production.

- Crude oil production will be increased at the Naval Petroleum Reserve at Elk Hills, California.

- The Alaskan crude oil pipeline is being modified to increase the throughput capability of the line and permit an expansion in Alaskan North Slope production by the end of 1979.

If the above actions are insufficient, the following additional actions would be taken as necessary:

- Utilities may be mandated to transfer base load power from coal, nuclear and hydro facilities to replace electrical generation from oil-fired facilities.
- Mandatory actions may be taken to require major utility and industrial users to switch from oil to natural gas if voluntary switching is insufficient.
- Gasoline sales may be restricted for part or all of weekends if voluntary reductions in gasoline use are insufficient. States are encouraged to develop alternative mandatory plans to save similar amounts of gasoline.
- A full crude oil allocation system may be required to distribute available crude oil on an equitable basis among all refiners.
- Mandatory refinery yield orders and product allocation fractions may be necessary to assure safe stock levels for next winter.

If the shortfall becomes even more severe:

- Additional mandatory measures to reduce gasoline consumption may be proposed.
- The Strategic Petroleum Reserve may be used if necessary to avoid disruptive shortage conditions.

The actions outlined in this Plan, if implemented early and effectively, should be sufficient to meet the U.S. commitment to the IEA and permit the United States to withstand the current world oil shortage without serious disruptions. Table A shows that the shortage can be eliminated if Americans reduce oil use as requested, including switching to alternative fuels, controlling building temperatures and reducing gasoline use. If other major consuming nations cooperate in taking similar reductions in consumption, the pressures to permanently increase world oil prices will be minimized.

TABLE A

ESTIMATED SAVINGS FROM RESPONSE MEASURES
(Thousands of Barrels Per Day)

	1979			1980
	Apr-Jun	July-Sept	Oct-Dec	Jan-Mar
Increased Domestic Production/ Reduced Consumption				
. Decontrol of Crude Oil Prices	-	-	60-80	100-120
. Increased Elk Hills Production	5	10	20	20
. Increased Alaskan Production	-	-	0-150	0-150
Immediate Demand Reduction Actions				
. State, Local, Private Initiatives to Save Gasoline	200-250	200-250	200-250	200-250
. Switch to Natural Gas	250-400	250-400	250-400	250-400
. Electricity Transfers	100-200	100-175	100-200	100-200
. Building Temperature Controls	55-110	175-350	195-390	180-375
. Reductions in Federal Use	12	16	19	29
Subtotal	622-977	751-1201	844-1509	879-1544
Additional Action if Necessary				
. Mandatory Weekend Gasoline Sales Restrictions or Alternative State Plans	-	135-270	120-235	110-220

DETAILS OF THE U.S. RESPONSE PLAN

I. U.S. Obligation to Reduce Oil Imports

At the March 1-2 International Energy Agency Governing Board Meeting, member countries decided to implement measures to help stabilize the world oil market and prices by reducing their demand for oil in world markets. Each government agreed to take measures, voluntary to the extent possible and mandatory to the extent necessary, to achieve a reduction of up to 5 percent in oil use. The measures to be implemented include both voluntary and mandatory conservation to reduce consumption, fuel switching, inventory management procedures, and increases in domestic production. The U.S. share of the reduction target would be nearly 1 MMB/D. The agreement provides for a reexamination of the level of savings required as the world oil supply conditions evolve.

II. Potential Stringency in World Oil Production

In addition to the reduction targets under the IEA commitment, two oil supply scenarios have been used in developing this response plan. These are not necessarily projections of what will occur, but rather provide a range of estimates of what could occur, to which the U.S. should be prepared to respond.

A. Base Case: This case assumes oil exports from Iran and other producers that result in a net supply shortfall of about 1 MMB/D through the first quarter of 1980. The need to rebuild inventories, the difficulties of sustaining production and exports in Iran, and reductions of supply by other producers combine to limit supply below projected world oil demand. Allocation of oil among nations is assumed to be on the basis of total oil consumption. Even if crude oil production is at a level adequate to meet normal demand, the current low level of petroleum stocks would result in a need to constrain demand.

B. More Severe Case: This case assumes a world oil shortfall of about 2 MMB/D starting in the third quarter of 1979 and continuing through the first quarter of 1980. This could result from more serious problems in Iran which prevent continued exports, or by further reductions in incremental surge production by other OPEC members.

Attachment 1 discusses the world oil supply picture.

III. Estimated Shortfalls in the U.S.

The estimated U.S. shortfalls below needed supply levels for the two scenarios are as follows:

Base Case
(in millions of barrels/day)

	1979			1980
	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr
U.S. Demand	18.8	18.7	20.3	20.8
U.S. Production	10.8	10.8	10.7	10.7
U.S. Imports	8.1	8.2	8.8	8.9
Total U.S. Supply	18.9	19.0	19.5	19.6
Normal Stock Changes	+ .4	+ .6	- .3	- .7
Shortfall from Constrained Imports	.3	.3	.5	.5
Shortfall Due to Low Stocks	.4	.4	-	-
Total Shortfall	.7	.7	.5	.5

More Severe Case
(in millions of barrels/day)

	1979			1980
	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr
U.S. Demand	18.8	18.7	20.3	20.8
U.S. Production	10.8	10.8	10.7	10.7
U.S. Imports	8.1	7.8	8.4	8.5
Total U.S. Supply	18.9	18.6	19.1	19.2
Normal Stock Changes	+ .4	+ .6	- .3	- .7
Shortfall from Constrained Imports	.3	.7	.9	.9
Shortfall Due to Low Stocks	.4	.4	-	-
Total Shortfall	.7	1.1	.9	.9

The impacts in the next six months of the world oil stringency on the U.S. market under the Base Case would be a shortfall of approximately 700,000 B/D. This includes a shortfall of about 300,000 to 360,000 B/D as the U.S. share of the 1 MMB/D world shortfall, and a shortfall of 360,000 to 390,000 B/D as a result of the need to rebuild low U.S. stocks.

The U.S. shortfall would decline to about 500,000 B/D by the fourth quarter of 1979 and the first quarter of 1980 (under the Base Case supply scenario), when U.S. stocks have been rebuilt.

Under the More Severe Case scenario, in which Iran or other producers cut back their production from their current levels, the U.S. shortfall could rise as high as 1.1 MMB/D in the third quarter, including the shortfall caused by the need to build stocks for the winter.

These estimates of the potential shortfalls to the United States assume the mid-range estimate of demand growth developed by the Energy Information Administration (EIA). The demand estimates assume normal oil supply conditions, prior to any conservation or fuel switching efforts as a result of the current oil shortfall and prior to any impacts of the March OPEC price increases. The EIA mid-range estimate is somewhat higher than other current estimates of demand. If the lower estimates were used, the estimated shortfalls in the last quarter of 1979 and first quarter of 1980 could be reduced by up to 250,000 B/D.

The impact on the U.S. of the reductions in Iranian oil exports, and estimates of potential shortfalls to the U.S. in the next year, are discussed in detail in Attachment 2.

IV. Ability to Use Industry Stocks

Industry petroleum stocks at the end of 1978 were generally at an acceptable level, but they had been reduced to abnormally low levels by the latter part of March. By the end of March, total petroleum stocks were estimated at about 70 MMB below estimated normal levels for this time of the year.

Total U. S. crude and product stocks at the primary level have been reduced by about 125 million barrels from the beginning of the year through the end of March. Industry stocks could not be reduced much further without causing operational problems or creating shortages in essential seasonal stocks. There are significant uncertainties about the ability to reduce stocks, and the reduction of safety stocks reduces industry's ability to respond to a further sudden reduction in supply or to a colder than normal winter. Therefore, the plan assumes no further reduction in total industry stocks after the first quarter of 1979.

Gasoline stocks will continue to be drawn down through September to meet increasing summer demand, but increases in distillate stocks for next winter need to more than offset the drawdown of gasoline stocks.

The drawdown of stocks has resulted in the use of much of the "safety stocks" normally maintained by industry to protect against supply and demand contingencies. The use of the safety stocks increases the risk of spot shortages of supplies.

Attachment 2 shows projected normal U.S. stock levels and estimated minimum acceptable stock levels for 1979, for total petroleum, gasoline and distillate. It also shows the preliminary actual stock levels through March 30.

V. Response Strategy

The primary objectives of the Response Plan are to:

- Meet the U.S. commitment to IEA to reduce petroleum consumption. Reducing demand for petroleum will remove market pressures to increase oil prices. Demand for oil which exceeds the feasible or desired production levels of exporting countries will encourage "premiums" above base prices. If demand can be reduced below desired production levels, there will be economic pressure to reduce or remove the premiums and to avoid or minimize future increases in base prices.
- Avoid any serious shortfalls of petroleum. The most critical times will be mid-to-late summer as gasoline use peaks, and in mid-to-late winter as distillate demand peaks and stocks are being drawn down rapidly.
- Rebuild industry safety stocks to provide greater protection against future supply or demand problems, such as unusually cold weather or future disruptions of imports.
- Avoid any unnecessary adverse impacts on the U.S. economy. A primary purpose of Government action is to help avoid or reduce the economic costs which might result if responses are based solely on the interests of each business and individual consumer.
- Help avoid major inequities among sectors of the economy or regions of the country.
- Be prepared to respond to more severe shortfalls. The Response Plan is intended to establish the framework for quick response by the Federal and State governments in the event foreign oil production is reduced substantially below current levels. Because of the very tenuous nature of current world oil production levels, the United States must be

prepared to respond quickly to changing conditions. Accordingly, this Plan includes plans for responding to a range of oil supply conditions during the coming year.

VI. Longer-Term Actions to Increase Petroleum Production and Decrease Demand

High priority is being given to increasing domestic crude oil production to reduce our dependence on unreliable foreign oil supplies. There is relatively little that can be done to increase U.S. production within the next 6 months, but it is critical that these efforts begin now if we are to reduce our vulnerability to the inevitable disruptions of foreign supplies in the future. It also is essential that prices of petroleum to U.S. consumers reflect its real value, to discourage the less efficient uses of petroleum.

Three specific actions are summarized below which will increase U.S. crude oil production. These actions also will have important longer-term benefits.

A. Phased Decontrol of Crude Oil Prices

The President's plan for phased decontrol of crude oil prices through 1981 is expected to result in increased crude oil production starting in 1979. It also is expected to reduce oil demand due to the effects of the higher prices to consumers. These combined effects could result in savings of about 60,000 to 80,000 B/D in the fourth quarter of 1979 and 100,000 to 120,000 B/D in the first quarter of 1980. See Attachment 3 for further information.

B. Increased Production From the Naval Petroleum Reserve at Elk Hills

DOE is accelerating efforts to increase production at the Elk Hills reserve by 20,000 barrels per day by the end of 1979, and by another 25,000 barrels per day by October 1980. This requires development of a water injection system at the reserve.

DOE also is working to resolve litigation with Chevron which is preventing production of 30,000 barrels per day at Elk Hills. This increase would be achieved within 90 days of a settlement of the case. See Attachment 4.

C. Increased Production from Alaska North Slope

Current crude oil production from the North Slope is approximately 1.2 million barrels per day. The amount of production is constrained by the throughput capability of the Alaska pipeline. Actions are now being taken by the Aleyeska pipeline company to increase the pipeline capability and to expand production to 1.35-1.4 million barrels per day by the end of 1979. This requires installation of additional pumping capability on the pipeline.

These actions could increase domestic oil production by 150,000 to 200,000 barrels per day above previous projections.

VII. Proposed Demand Reductions and Other Response Measures

A. Immediate Actions

The following actions either have been implemented or are to be implemented as soon as possible, to constrain demand in the second quarter. These are actions which are expected to have little or no adverse economic impacts.

1. State, Local and Private Initiatives

- o Each State has been urged by the President to implement a plan of its choice to reduce gasoline consumption, to meet specific savings targets. Successful implementation of such plans could avoid the need to use mandatory Federal plans to reduce gasoline consumption.
- o Community leaders, industrial and commercial firms, and other major users of oil are requested to set voluntary targets and specific implementing actions for reducing oil consumption. Programs may include assistance and incentives for using carpools and vanpools or public transit; efforts by business firms to

reduce gasoline used for employee commuting; and community campaigns to reduce discretionary driving.

- State governments have been requested by the President to establish targets to reduce their direct government use of gasoline in motor vehicles by 10 percent, and to control their building temperatures at no cooler than 80 degrees in the summer and no warmer than 65 degrees in the heating season.

- The Department also is instituting a major public information effort aimed at reducing gasoline use, and controlling temperatures in homes and offices at 65° in the heating season and 80° in the cooling season. Every driver has been requested by the President to reduce travel by 15 miles per week. If all drivers were to reduce travel by 15 miles per week, it could save 450,000 B/D of oil.

- For purposes of developing total estimates of import savings from these actions, it was assumed that gasoline use would be reduced by approximately 3 percent or by 200,000 to 250,000 B/D, which is at the low end of the range of estimated savings from the above actions. It also was assumed that fuel oil savings would range between 200,000 and 400,000 barrels per day as a result of either voluntary or mandatory building temperature controls. See Attachment 5 for further information.

2. Encourage/Assist Switching to Alternative Fuels

- The Administration is continuing the efforts started in January to maximize the use of the temporary natural gas bubble by urging that existing dual-fired facilities be switched from oil to gas. The Natural Gas Policy Act of 1978 has provided the essential foundation for this program by facilitating the transfer of surplus gas from the intrastate market to the interstate market. The Department is encouraging sales between intrastate and interstate pipelines, and direct purchase arrangements between end users and producers or pipelines to facilitate this emergency gas conversion program. Savings of over 200,000 B/D of oil were already occurring in late March as a result of this effort. Estimated savings are 250,000 to 400,000 B/D. See Attachment 6 for further information.

- The Department of Energy will be encouraging utilities to transfer electricity from coal burning and hydro powered facilities to utilities which are now using oil. It is expected that oil savings averaging about 100,000 barrels per day can be sustained through voluntary transfers of power. Major electric utility and power pools are already engaging in voluntary inter-regional transfers which have the direct effect of displacing oil use. Larger savings of up to 200,000 B/D are possible, particularly if substantial transfers of power from Canada are continued.

  At this time, it is unclear to what extent electricity transfers will result in a net reduction in oil use from projected levels. The recent accident at the Three Mile Island nuclear plant, in addition to the shutdown of 5 other nuclear plants for safety reasons, will increase oil use significantly this summer if these units remain out of service for an extended period. This could offset some of the savings from electricity transfers. See Attachment 7.

3. Deferring the Phasedown of Lead in Gasoline

The Environmental Protection Agency is proceeding with an expedited rulemaking to defer the planned requirement that refiners phase down lead levels in gasoline to .5 grams per gallon starting in October 1979. Instead, refiners would be required to limit lead to .8 grams per gallon, and to increase production of unleaded gasoline to assure adequate supplies for the increasing numbers of automobiles that are to use only unleaded gasoline. Prior to October 1, refiners will be given waivers from the current .8 grams per gallon limit subject to commitments to increase unleaded gasoline production.

This action will save 10,000 to 15,000 B/D of oil between now and October. More importantly, it will avoid the loss of 260,000 to 340,000 B/D of gasoline production capability, and the use of up to 30,000 B/D of additional oil, starting in October. See Attachment 8.

4. Building Temperature Controls

Mandatory building temperature controls will be implemented upon approval of the conservation plan by Congress.

A mandatory conservation Plan to require setting thermostats at no higher than 65° in the heating season and no lower than 80° in summer in commercial, industrial and public buildings has been submitted for Congressional approval. This measure is expected to have little or no adverse economic impact. Because building owners/managers have an incentive to comply, high levels of compliance are likely. This action will be particularly useful in saving oil use to rebuild distillate stocks before next winter. Estimated savings from application to commercial, industrial and public buildings range from 175,000 to 390,000 barrels/day, depending on time of year and level of compliance. See Attachment 9.

5. Higher Sulfur Limits for Residual Oil

The reduction in Iranian exports has curtailed the supply of low sulfur fuel oil that is needed to meet environmental standards.

The Administration is determined to prevent environmental health regulations from being used as an excuse for price-gouging. In cases where shortages of low-sulfur fuel oil appear to exist, and where states request temporary suspension of Clean Air Act standards, the Administrator of EPA will consider unusually large increases in the price differential between complying and non-complying fuels as a basis for recommending approval of state suspension requests. The President has directed the Administrator of EPA to use his full authority to take into account price differentials and to provide the President with information on price differential increases when making recommendations to him on such requests. The President also will consult with the Secretary of Energy prior to making his determination.

6. Mandatory Actions by Federal Agencies

The President has directed all Federal agencies to reduce energy consumption by 5 percent. As part of this effort, all agencies are required to reduce use of gasoline in Federal vehicles by 10 percent, and control building temperatures at no warmer than 65° in winter and no cooler than 80° in summer.

As part of the effort to encourage Federal employees to use carpools, vanpools, or public transit, action is proceeding to begin charging full commercial rates for employee parking spaces provided by Federal agencies in urban areas. The full commercial rate is to be phased in, starting in October 1979. See Attachment 10.

7. Voluntary Distillate Stock Build Up Program

The Department will work with refiners to establish individual distillate stock level targets for October 1, 1979, to reach a total distillate primary stock level of 240 MMB by October 1. Intermediate monthly targets also may be established. DOE will take steps to be prepared to require refinery yield shifts if this becomes necessary to build distillate stocks to safe levels.

If gasoline demand cannot be met because of the reduced stocks, constrained imports and the need to rebuild distillate stocks, refiners may be requested to allocate gasoline supplies voluntarily, using an allocation fraction suggested by the Department. DOE will be prepared to impose a mandatory industry-wide allocation program if necessary. See Attachment 12.

8. Crude Oil Allocation

If smaller refiners have serious crude oil shortages, DOE will direct larger refiners to sell crude oil to the smaller refiners under the current Buy/Sell program. If serious inequities in supplies of crude oil develop for larger refiners, DOE is prepared to take a range of actions, including using the current Buy/Sell program, establishing a separate Buy/Sell program for larger refiners, or implementing the full crude oil allocation program to allocate oil to all refiners based on a fraction of pre-interruption oil supplies. See Attachment 12.

B. Additional Actions if Early Actions are Inadequate

The following actions would be implemented only if the early actions are inadequate to deal with the problem.

1. Require Electricity Transfers

Use available authority to mandate electricity transfers from coal, nuclear, and hydro sources to displace oil-fired generation, if voluntary savings are inadequate. Estimated savings are 100,000 to 200,000 barrels/day, including voluntary transfers. See Attachment 7.

2. Ensure Maximum Use of the Temporary Natural Gas Bubble

If the voluntary switching from oil to natural gas is insufficient, the Department will explore use of its allocation and other authorities to ensure this fuel switching. Savings could reach 400,000 to 500,000 B/D.

3. Restricting Gasoline Sales on Weekends

A mandatory conservation Plan has been submitted to Congress for its approval to permit the President to prohibit sales of gasoline for part or all of the weekend. The restrictions would also apply to pumps for aviation gasoline and fuel for boats. This action is estimated to have significant adverse economic impacts, chiefly in the tourism and recreational industries. It may cause some gas lines on Mondays and prior to the weekend. Estimated savings range from 110,000 to 270,000 barrels/day. States will have an opportunity to develop alternative proposals which may be more suited to the needs of the individual States. See Attachment 11.

4. Allocation of Products

Mandatory product allocation and refinery yield orders will be used if necessary to prevent excessive stock drawdown or to assure build up of adequate distillate stocks. It also may be used to allocate any remaining product shortages equitably among users if demand restraint measures are insufficient. In particular, allocation of gasoline may be necessary to equitably distribute shortages and to assure adequate build-up of distillate stocks for next winter's heating season. Product allocation can be implemented selectively or on all products. See Attachment 12.

C. Further Actions if the Shortage is Greater and if Demand Reduction Measures are Inadequate

1. Additional Mandatory Conservation Plans

Additional mandatory conservation plans are now under study and proposals may be completed this summer for use if the other available measures are insufficient.

2. Use the Strategic Petroleum Reserve (SPR)

The SPR will be used only if necessary to avoid chaotic supply conditions in the event of a large, sudden increase in the shortfall. The SPR could be used to provide a more gradual reduction in consumption than would otherwise be possible.

The SPR could be used to help avoid the most serious economic impacts of a long interruption. However, if there is a long-term reduction in world oil production, the use of the SPR will only delay the time when the U.S. economy will have to adjust to a lower level of consumption. After use of the SPR, the U.S. would be completely vulnerable to a more severe, short-term interruption.

By May 15, temporary drawdown facilities will be in place to permit drawdown at the rate of about 125,000 barrels per day. By October, a drawdown rate of about 1 million barrels per day will be possible.

3. Gasoline Rationing

Gasoline rationing would not be necessary except for conditions substantially more dire than the More Severe Case.

VIII. Summary of Potential Shortfalls and Savings

The following table summarizes the potential shortfalls from the two supply cases, and shows the estimated savings from each of the production, conservation and fuel switching measures being implemented.

The table shows that the U.S. can accomplish savings in accord with the U.S. obligations to the International Energy Agency, with a reasonable level of participation by Americans in reducing energy use.

Potential savings of petroleum use are more than adequate to cover the shortfall under the Base Case, with reasonable restraint in demand by all Americans. In the More Severe Case, the reductions may be inadequate in the third quarter of 1979 except with large voluntary conservation savings.

The reductions in use of distillate will be adequate to offset shortfalls and rebuild distillate stocks for next winter if the estimated savings are achieved from switching to natural gas and building temperature controls. The savings from these actions, plus additional potential savings from electricity transfers, could permit refiners to continue to produce relatively high levels of gasoline, rather than constrain gasoline production in order to build up distillate stocks. However, if the distillate savings are inadequate and stocks are not being rebuilt to safe levels, it will be necessary for the Department to require refiners to shift production from gasoline to distillate, to build stocks to acceptable levels. This would then result in greater shortages of gasoline, and may require allocation of gasoline.

The estimate of 200,000 to 250,000 B/D of savings in gasoline use may be adequate to avoid shortfalls under the Base Case, unless there is a need to reduce gasoline production in order to increase distillate stocks. Under the More Severe Case, higher levels of gasoline savings may be required if shortfalls are to be avoided.

The Department will monitor and report on the supply, demand and stock levels of petroleum products to assure that the U.S. meets its commitment to IEA. The Department will inform the American people of the progress in achieving this goal and of any further steps that may be necessary.

TABLE A

ESTIMATED SAVINGS FROM RESPONSE MEASURES
(Thousands of Barrels Per Day)

	1979			1980
	Apr-Jun	July-Sept	Oct-Dec	Jan-Mar
Increased Domestic Production/ Reduced Consumption				
. Decontrol of Crude Oil Prices	-	-	60-80	100-120
. Increased Elk Hills Production	5	10	20	20
. Increased Alaskan Production	-	-	0-150	0-150
Immediate Demand Reduction Actions				
. State, Local, Private Initiatives to Save Gasoline	200-250	200-250	200-250	200-250
. Switch to Natural Gas	250-400	250-400	250-400	250-400
. Electricity Transfers	100-200	100-175	100-200	100-200
. Building Temperature Controls	55-110	175-350	195-390	180-375
. Reductions in Federal Use	12	16	19	29
Subtotal	622-977	751-1201	844-1509	879-1544
Additional Action if Necessary				
. Mandatory Weekend Gasoline Sales Restrictions or Alternative State Plans	-	135-270	120-235	110-220

Attachment 1

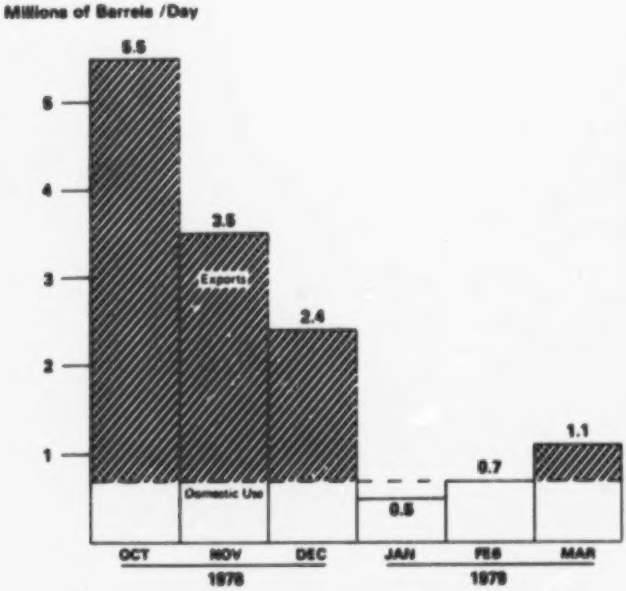
THE WORLD OIL SUPPLY PICTURE

Iranian Production

At the beginning of the fourth quarter of 1978, Iran ranked as the fourth largest producer of oil in the world and the world's second largest oil exporter. Iran's exports at that time averaged more than 5 million barrels per day (MMB/D) and provided approximately 10 percent of all oil consumed by non-Communist countries.

Following a series of political strikes and slowdowns in the Iranian oil fields, oil production dropped to about .5 MMB/D on December 26, 1978. This level of production was insufficient to support even Iran's domestic needs and exports came to a total halt. No crude oil was exported from Iran until March 5, 1979, when exports resumed at levels of about 1 MMB/D. Since then, Iran's production has increased to about 2.5 MMB/D, with approximately 1.8 MMB/D available for export.

Chart 1
Iran: Oil Production & Exports



The resumption of Iranian exports since March 5 has eased the oil supply crisis, although it will take 30-60 days for the renewed Iranian exports to arrive in the consuming countries and to alleviate physical shortfalls in the U.S., Europe and Japan. In addition, the cumulative shortfall of about 200 MMB since November represents an undesired draw-down of inventory that will have to be replaced primarily prior to next winter; this requirement will place additional demand pressure on world oil markets during the rest of this year. Finally, the Iranian government has indicated its intention to produce 3.5 to 4.0 MMB/D in the second quarter. Even if this level is sustained, it represents a reduction of 2 to 2.5 MMB/D from the level maintained prior to the change in regimes last year.

Other World Production

As Iran's oil production fell late last year, major exporting countries increased production. In particular, Saudi Arabia increased production by 1.4 MMB/D above its projected production level, while other major production increases came from Kuwait, Iraq, Venezuela and Nigeria. Table 1 provides a complete list of production changes during the first quarter of 1979, including estimated average total production by Iran during the first quarter.

Table 1

IMPACT OF IRANIAN CURTAILMENT ON FREE WORLD OIL PRODUCTION 1/
(Millions of Barrels/Day)

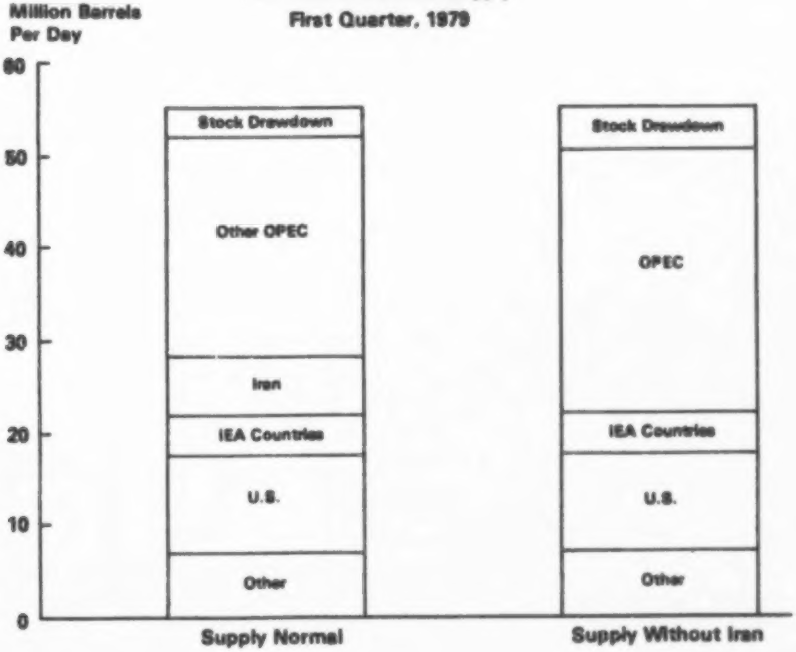
	Fourth Quarter 1978			First Quarter 1979		
	Projected	Actual	Change	Projected Before Iran Curtailment	Projected After Iran Curtailment	Change
OPEC						
Iran	6.2	3.8	-2.4	5.9	1.1 2/	-4.8
Saudi Arabia	9.2	10.2	1.0	8.7	10.1	1.4
Iraq	2.7	3.1	0.4	2.7	3.1	0.4
Nigeria	2.2	2.3	0.1	2.2	2.4	0.2
Kuwait	2.3	2.4	0.1	2.0	2.6	0.6
Libya	2.1	2.1	-	2.1	2.2	0.1
Venezuela	2.3	2.4	0.1	2.2	2.4	0.2
Other OPEC	5.6	5.8	0.2	5.6	5.8	0.2
Total OPEC	32.6	32.1	-0.5	31.4	29.7	-1.7
Non-OPEC						
United States	10.3	10.3	-	10.8	10.7	-0.1
Canada	1.6	1.7	0.1	1.7	1.8	0.1
North Sea	1.7	1.7	-	1.7	1.8	0.1
Other Dev Countries	0.8	0.8	-	0.9	0.9	-
Mexico	1.5	1.4	-0.1	1.5	1.5	-
Other LDCs	3.5	3.5	-	3.5	3.5	-
Net CPE Exports	1.0	1.0	-	1.0	1.0	
Total Non-OPEC	20.4	20.4	-	21.1	21.2	0.1
Total Production	53.0	52.5	-0.5	52.5	50.9	-1.6

1/ Includes natural gas liquids and processing gains.
2/ Production at 600,000 b/d from Jan 1 to Mar 3, rising to 2.5 MMB/D by March 13, maintained at 2.5 MMB/D for rest of month.

Production increases in these other countries alleviated about 3 MMB/D of the 5 MMB/D shortfall resulting from the loss of Iranian exports in the first 2 months of 1979. Oil supplies available to free world consuming countries have been estimated at about 51 MMB/D during that period, or about 2 MMB/D below expected levels. Because Iran resumed exports at a low level starting March 5, the estimated average daily shortfall for the full three months of the first quarter is estimated at 1.6 MMB/D, as shown in Table 1. The cumulative net shortfall of world oil supplies has been approximately 200 million barrels.

The net shortfall was made up primarily through the drawdown of petroleum inventories. Chart 2 summarizes the effects of increased OPEC production and the loss of Iranian supplies on the world supply situation for the first quarter of 1979.

Chart 2
Free World Petroleum Supply
First Quarter, 1979

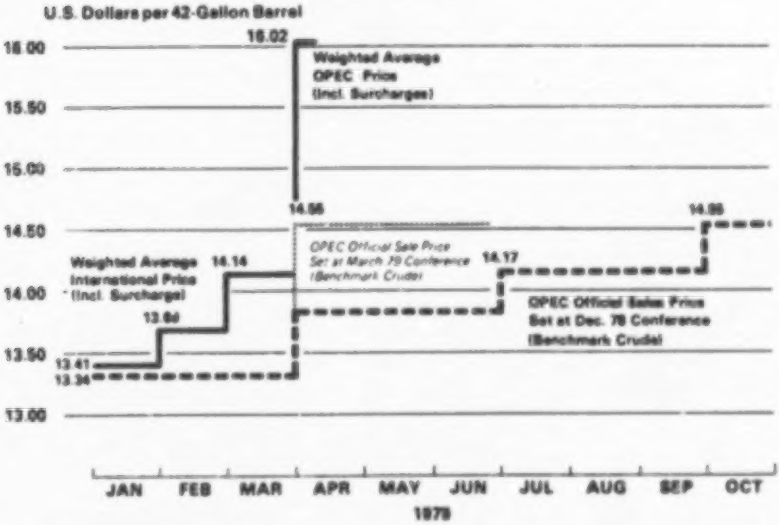


The 2 MMB/D shortfall in supply and the corresponding drawdown of inventories led to widespread pressure on world oil prices. Price increases appeared first in January for the small volumes traded in spot markets and which were then translated into a series of surcharges by various producers in February. On the eve of the March 26 OPEC meeting, these surcharges averaged $1.73/bbl and applied to 46 percent of internationally traded oil for an average price increase of 80 cents/bbl as shown below in Chart 3. Prices shown do not include transportation charges of $1.00 to $1.50 per barrel for shipment to the U.S., nor do they reflect the fact that the U.S. import mix is weighted towards light, premium crudes which adds $0.75 to $1.00 to the average U.S. import price.

Recognizing these pricing trends, OPEC decided on March 27 to raise its minimum prices by about 9 percent for the second quarter. These price increases moved the scheduled fourth quarter 1979 price forward to the second quarter and explicitly authorized the continuation of the surcharges which had appeared in February. Whether these surcharges will continue for the balance of the year will depend largely upon demand from the U.S. and other countries. Strong demand for oil will not only sustain the surcharges but also could lead to further increases in the official "base" price.

Chart 3

World Price of Oil



Internationally Traded Oil Only

Summary of World Supply, Stocks and Demand

Given the changes in Iranian and other world production described above, the net loss of world petroleum production amounted to approximately 1.6 MMB/D during the first quarter of 1979. The cumulative effect of the curtailment in Iranian supplies has been a loss of about 200 million barrels of world oil supplies.

In the first quarter of 1979, the shortfall was relieved in part by drawing down industry stocks at higher than normal rates; this will affect the ability of consuming nations to meet peak demands for gasoline this summer while rebuilding fuel oil stocks to required levels for next winter.

Outlook for the Next Year

Because of the uncertainty which surrounds the current oil supply situation, supply projections for the next year cannot be precisely defined. For that reason, two scenarios have been defined to illustrate alternative developments in world oil markets over the next 12 months. These do not represent projections of what will occur, but rather provide a range of situations to which the United States should be prepared to respond. In calculating U.S. oil import levels, this analysis assumes that the U. S. share of any world oil shortfall is determined on the basis of the U.S. share of free world consumption, in keeping with the principles of the International Energy Agency's emergency sharing system. To the extent that companies would allocate the shortfall on the basis of the U.S. share of free world imports, the shortfall in U.S. oil imports would be somewhat lower.

World Supply Base Case

This case assumes a volume of exports from Iran and other producers that results in a net shortfall of supply on the order of 1 MMB/D from projected world demand. The need to rebuild inventories, the difficulties of sustaining production and exports in Iran, and reductions of supply by other producers combine to maintain pressure on world oil markets leading to further price increases until demand is brought into line with available supplies.

Estimated potential imports to the U.S. under this case range from 8.1 MMB/D in the second quarter, to 8.9 MMB/D in the first quarter of 1980. This is about 25 percent of total free world imports. (U.S. imports in the following two tables are on a 50-state basis and exclude SPR requirements in order to be consistent with EIA definitions in its Monthly Energy Review.)

Table 2

Base Case
(Millions of Barrels/Day)

	1979				1980
	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar
Demand:					
U.S.	20.7	18.5	18.4	20.0	20.5
Canada	1.9	1.8	1.8	1.9	2.0
W. Europe	15.5	13.6	13.1	15.2	15.9
Japan	6.0	5.2	5.4	5.9	6.1
Other Free World	11.6	11.5	11.4	11.5	12.0
Total Free World	55.7	50.6	50.1	54.5	56.5
Supply:					
OPEC	29.7	30.6	30.8	30.8	30.8
Non-OPEC	20.7	21.0	21.1	21.4	21.6
Processing Gain	.5	.5	.5	.5	.5
Total	50.9	52.1	52.4	52.7	52.9
Stock change:	-4.8	+1.5	+2.3	-1.8	-3.6
Imports to U.S.	8.6	8.1	8.2	8.8	8.9

World Supply More Severe Case

This case assumes a return to the more serious 2 MMB/D shortfall experienced earlier this year, caused by either another cessation of Iranian exports or by more severe curtailments of supply from other exporters. While perhaps not as likely as the precarious tight market of the Base Case, it remains a highly possible turn for the worse that would drive oil prices to much higher levels and require more drastic reductions of demand on the part of oil importing countries.

Table 3

More Severe Case
(Millions of Barrels/Day)

	1979				1980
	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar
Demand:					
U.S.	20.7	18.5	18.4	20.0	20.5
Canada	1.9	1.8	1.8	1.9	2.0
W. Europe	15.5	13.6	13.1	15.2	15.9
Japan	6.0	5.2	5.4	5.9	6.1
Other Free World	11.6	11.5	11.4	11.5	12.0
Total Free World	55.7	50.6	50.1	54.5	56.5
Supply:					
OPEC	29.7	29.6	29.8	29.8	29.8
Non-OPEC	20.7	21.0	21.1	21.4	21.6
Processing Gain	.5	.5	.5	.5	.5
Total	50.9	51.1	51.4	51.7	51.9
Stock change:	-4.8	+0.5	+1.3	-2.8	-4.6
Imports to U.S.	8.6	8.1	7.8	8.4	8.5

Estimated potential imports to the United States under the More Severe Case range from 8.1 MMB/D in the second quarter of 1979 to 8.5 MMB/D in the first quarter of 1980, ranging from 26 percent to 27 percent of free world imports.

Attachment 2

IMPACTS ON THE UNITED STATES OF THE WORLD OIL SUPPLY SHORTFALL

I. Impacts During the First Quarter of 1979

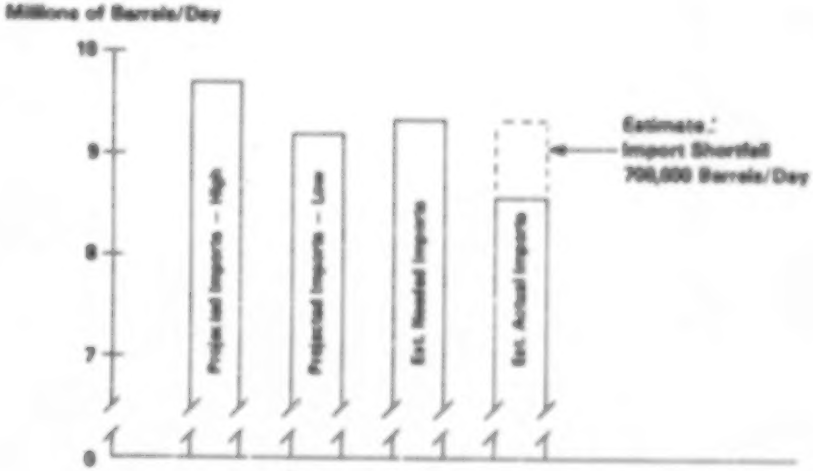
Imports

During the past three months, U.S. oil imports have averaged approximately 8.6 MMB/D. They had been projected to average between 9.2 and 9.7 MMB/D in order to meet normal U.S. petroleum demands. Because of the high demand during January and February for heating oil, gasoline and other products, imports should have averaged about 9.3 MMB/D during the first quarter in order to avoid excessive draw-down of U.S. oil stocks. Thus, the imports of 8.6 MMB/D were about 0.7 MMB/D less than would have been desirable. This is illustrated in the following chart.

Chart 1

U.S. Import Shortfall

First Quarter 1979



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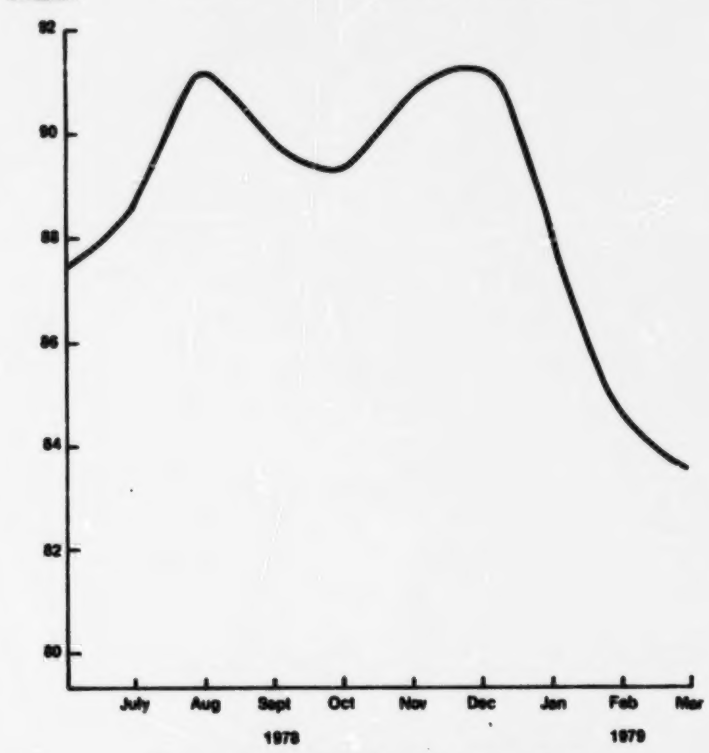
Refinery Utilization

Because of the shortfall of crude oil imports, it was necessary for refiners to reduce throughput at refineries, resulting in lower output of refined products.

The refinery utilization rate dropped from 91 percent last December to 88 percent in January, 84.5 percent in February, and 83.5 percent in March. This is shown on Chart 2.

CHART 2
U.S. Refinery Capacity Utilization



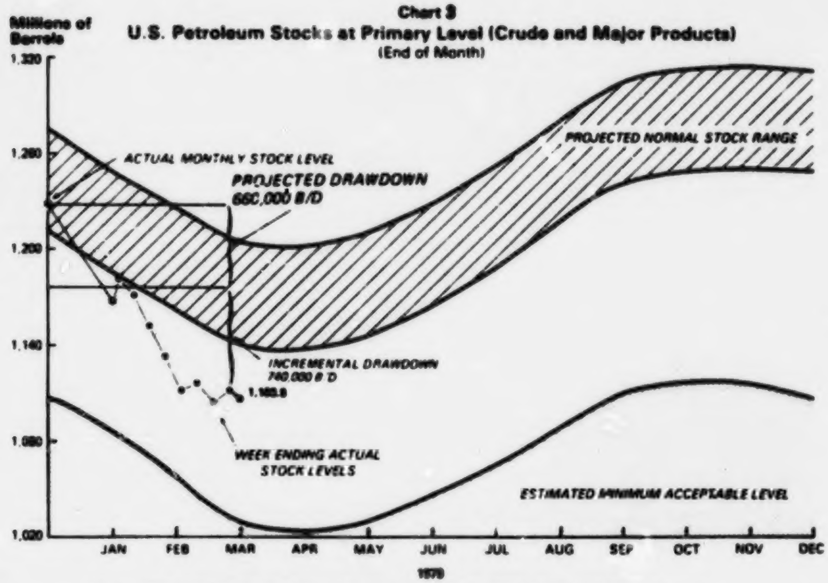
Source: July 1978 through September 1978: EIA *Energy Data Reports* "Monthly Petroleum Statement." October 1978 through December 1978: EIA "Monthly Petroleum Statistics Report. January 1979 through March 1979: estimates based on data from the American Petroleum Institute "Weekly Statistical Bulletin"

Industry Stocks

The shortfall of imports has been offset by using industry petroleum stocks at a faster rate than projected. The projected rate of stock drawdown during the first quarter of 1979 was about 0.7 MMB/D. The reported reduction in stocks is expected to have been about 1.4 MMB/D, or about 0.7 MMB/D faster than projected.

As shown in Chart 3, total crude oil and product stocks have declined by a total of 125 MMB from the end of December through March 30.

Chart 3
U.S. Petroleum Stocks at Primary Level (Crude and Major Products)
(End of Month)



Soure Week ending average data American Petroleum institute (API) "Weekly Statistical Bulletin"; Projections and estimates 1979 DOE Emergency Policy Council, Iranian Response Plan Actual Monthly Data (December 1978 January 1979) EIA "Monthly Petroleum Statistics Report.

Notes (1) Projected Normal Stock Range —projections are based upon trends and seasonal patterns inherent in Bureau of Mines and DOE Actual Monthly Data from 1972-1978. The Band shown indicates a range of plus or minus one standard error That is, extrapolations would fall inside the band approximately 2/3 of the time

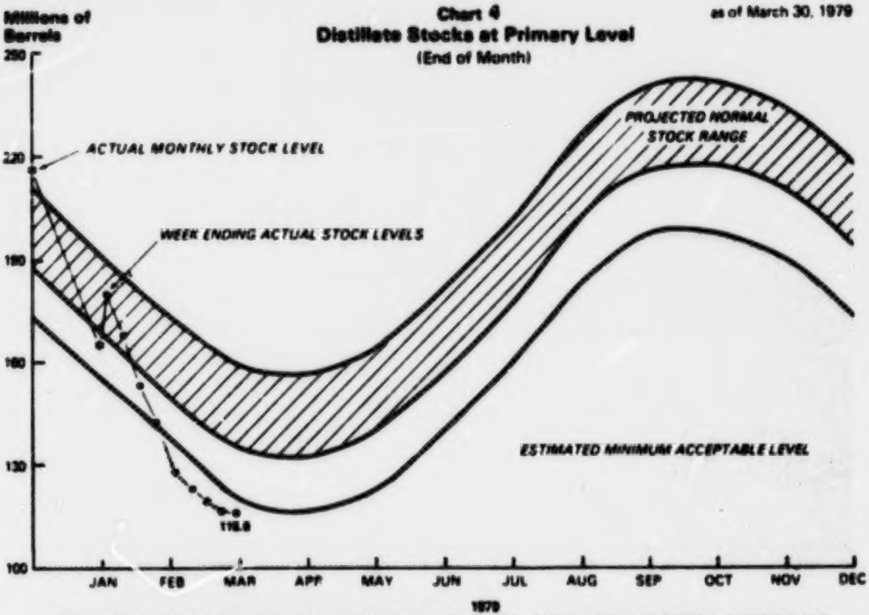
(2) Estimated Minimum Acceptable Level – The level that stocks can fall to without disruption of consumer deliveries or the creation of spot shortages. This level is based upon the frequency with which stocks have fallen below normal patterns as determined from Bureau of Mines and DOE Actual Monthly Data from 1972 1978 and upon recent analysis of inventory requirements for efficient operation

(3) Product Stocks at the Primary Level include those held at refineries, in pipe lines, and at major bulk terminals. Crude Stocks at Primary Levels include those held at refineries in pipe lines, and in leased tanks.

The large oil stock drawdown has particularly affected distillate stocks. These stocks have fallen below estimated minimum acceptable levels. The nation's weather has been colder than normal--by about 6 percent through March 26--and has contributed to the high rate of stock use, along with the shortfall of imports. As a result of these distillate stock drawdowns, spot shortages have appeared in several areas, and prices for end-users have risen rapidly.

Chart 4
Distillate Stocks at Primary Level
(End of Month)

as of March 30, 1979



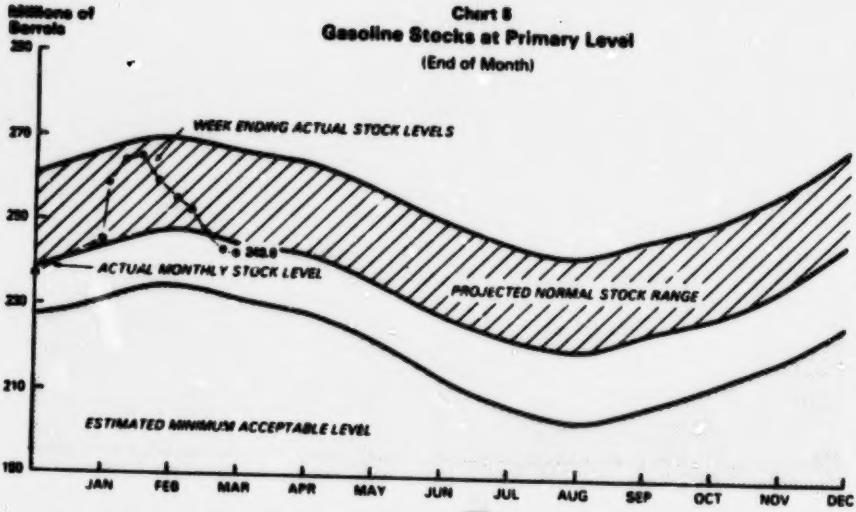
Source: Week ending average data: American Petroleum Institute (API), "Weekly Statistical Bulletin"; projections and estimates through 1979: DOE Emergency Policy Council, Iranian Response Plan. Actual Monthly Data (December 1978, January 1979): EIA "Monthly Petroleum Statistics Report."

Product stocks at the Primary Level include those held at refineries, in pipe lines, and at major bulk terminals.

See notes (1) and (2) of U.S. Petroleum Stocks at Primary Level.

Stocks of other products have also declined by larger-than-projected amounts. Motor gasoline stocks, for example, declined between mid-February and March 23 by 21.6 MMB. These stocks declined at a rate of over 630,000 B/D during those 5 weeks and are now slightly below estimated normal levels for this time of year.

Chart 8
Gasoline Stocks at Primary Level
(End of Month)



Source: Week ending average data: American Petroleum Institute (API), "Weekly Statistical Bulletin"; projections and estimates through 1979: DOE Emergency Policy Council, Iranian Response Plan. Actual Monthly Data (December 1978, January 1979): EIA "Monthly Petroleum Statistics Report."

See notes (1) and (2) of U.S. Petroleum Stocks at Primary Level

Summary of Supply and Demand

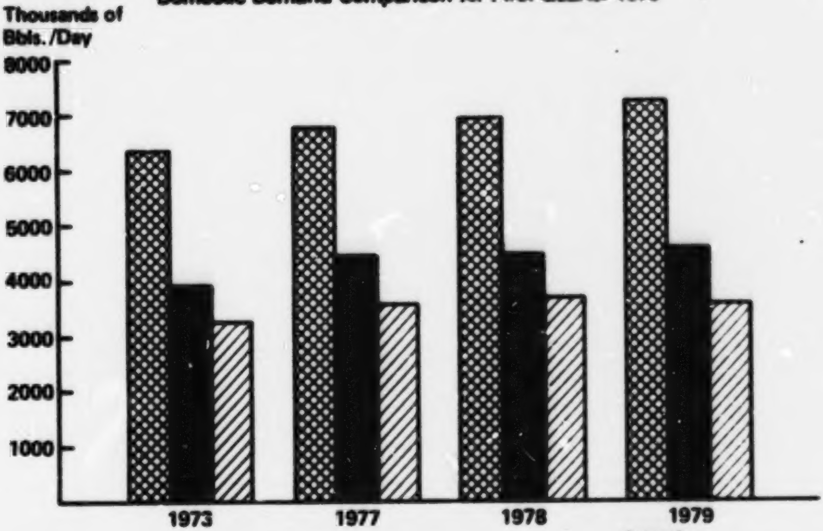
As a result of Iran-related oil production cutbacks, the U.S. in early 1979 experienced lower oil imports (of 8.6 MMB/D) and higher stock drawdowns (of 1.4 MMB/D) than projected. Domestic production has been at about the level projected, or about 10.7 MMB/D, including processing gains. The total of these three sources of supply, which is defined as total demand, was thus approximately 20.7 MMB/D for the first quarter.

Overall demand has not been unexpectedly strong for normal conditions, but there appears to have been little reduction in U.S. oil usage during the first quarter of 1979 as a result of the Iranian problem.

Of particular concern is that demand for motor gasoline has been averaging nearly 100,000 B/D more than the high estimate of demand for the first quarter. This is an increase of 4.5 percent over the year-earlier levels. The demand for residual fuel oil has declined slightly from last year and demand for most other petroleum products has risen less rapidly, by comparison.

Chart 6

Domestic Demand Comparison for First Quarter 1979



	1973	1977	1978	1979
Motor Gasoline	6353	6755	6938	7252
Distillate Fuel Oil	3913	4408	4441	4585
Residual Fuel Oil	3253	3550	3653	3530

In summary, the United States during the past 3 months has experienced significant negative effects from the reduction in world oil production. U.S. oil imports fell short by about 700,000 B/D from expected requirements. The U.S. share of the overall shortfall seems consistent with its share of free world oil use. This shortfall in imports was caused in part by overall strong demand in spite of higher prices. Thus oil stocks were drawn down at more than twice the projected rate during the first quarter, creating undesirably low stock levels.

U.S. Petroleum Prices

The world oil shortfall also has adversely affected U.S. oil prices. Retail prices have been rising rapidly. Preliminary estimates indicate the average retail price of regular unleaded gasoline rose since the beginning of the year by about 4 cents, or about 7 percent. Further increases seem certain in the months ahead. Similar increases have befallen heating oil, for which national average residential prices rose from just over 48 cents in August to almost 54 cents by early this year, more than twice the normal seasonal increase.

If markets remain tight, price pressures will continue. The recently announced increase in crude oil prices by OPEC of 9 percent plus surcharges is a reflection of the continued high demand for oil in conjunction with tight supply levels.

II. The U.S. Supply Picture for the Next Year

This section shows the potential oil shortfalls during the coming year for the two world supply cases discussed earlier.

Assumptions Regarding The Future

Because there is no certainty about the future of world oil supplies, two levels of imports have been used, corresponding to the Base Case and the More Severe Case in the world supply outlook discussed in Attachment 1. A single, projection of demand has been used which is the midpoint of the range of projected growth developed by the Energy Information Administration (EIA). The demand estimates assume normal oil supply conditions, prior to any conservation or fuel switching efforts as a result of the current oil shortfall and prior to any impacts of the March OPEC price increases.

These projections of supply and demand are shown on a quarterly basis in Table 1 below.

Table 1

(Millions of Barrels/Day)

	1979			1980
	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar
Demand:				
Projected Consumption	18.84	18.68	20.33	20.77
Stock Build-up	.75	1.05	0	0
Total Demand	19.59	19.73	20.33	20.77
Supply:				
Domestic Supply	10.80	10.83	10.75	10.68
Imports:				
Base Case	8.07	8.21	8.77	8.93
More Severe Case	8.07	7.81	8.37	8.52
Stock Drawdown	0	0	.30	.66
Total Supply:				
Base Case	18.87	19.04	19.82	20.27
More Severe Case	18.87	18.64	19.42	19.86
Shortfall:				
Base Case	.72	.69	.51	.50
More Severe Case	.72	1.09	.91	.91

Total Petroleum Shortfalls for the U.S.

The two supply cases assumed above would result in the following average daily shortfalls for the United States:

Table 2

(Thousands of Barrels/Day)

	1979			1980
	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar
Base Case	720	690	510	500
More Severe Case	720	1090	910	910

The estimated shortfalls reflect the higher than normal oil demand to rebuild petroleum stocks from current low levels, by October, as well as the shortfalls in future imports to meet current consumption. This is shown below:

Table 3

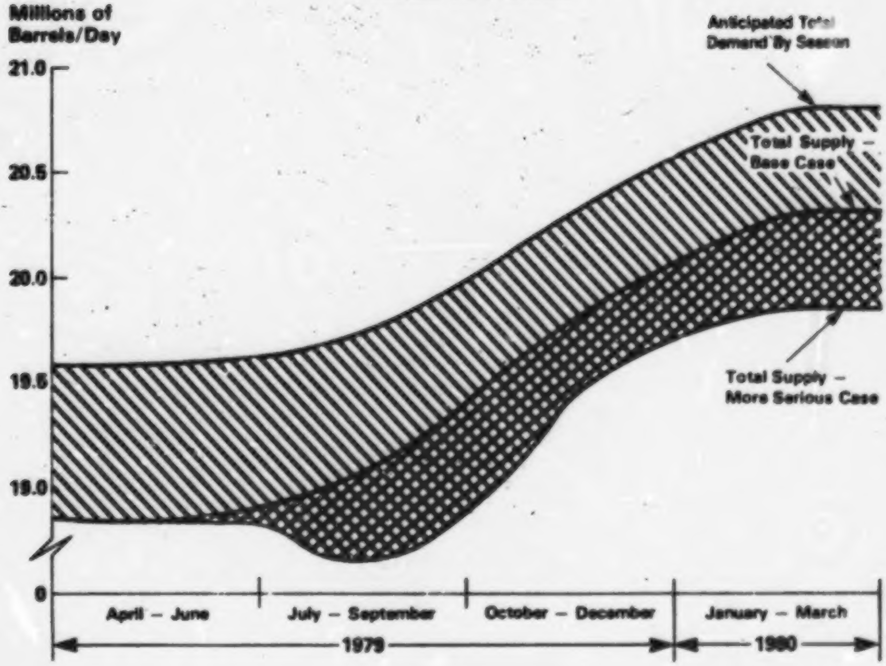
(Thousands of Barrels/Day)

	1979			1980
	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar
Base Case				
Shortfall Due to Low Stocks	360	390	0	0
Reduced Current Imports	360	300	510	510
Total Shortfall	720	690	510	510
More Severe Case				
Shortfall Due to Low Stocks	360	390	0	0
Reduced Current Imports	360	700	910	910
Total Shortfall	720	1090	910	910

The shortfalls in supplies under the two cases are shown graphically in Chart 7.

Chart 7

Potential Oil Shortfalls



The single-hatched area shows that the potential shortfall in the Base Case could be about .7 MMB/D in the second and third quarters and about .5 MMB/D through the fourth quarter of 1979 and first quarter of 1980. The More Severe Case is depicted by the total shaded area. The shortfall under this scenario increases to about 1.1 MMB/D in the third quarter and to .9 MMB/D in the following two quarters.

In both supply cases, the most critical period for the United States will be the next 6 months. It will be during this period that gasoline demand will peak for the year, and it will be necessary to rebuild low distillate stocks for next winter, by October.

Gasoline Supplies

The shortfalls of gasoline under the two supply cases would be approximately as follows:

Table 4

(Thousands of Barrels/Day)

	1979			1980
	Apr-Ju	Jul-Sep	Oct-Dec	Jan-Mar
Base Case				
Shortfall due to				
Low Stocks	65	110	0	0
Reduced Current Imports	160	135	220	220
Total Shortfall	225	245	220	220
More Severe Case				
Shortfall due to				
Low Stocks	65	110	0	0
Reduced Current Imports	160	310	380	380
Total Shortfall	225	420	380	380

The shortfalls from stocks reflect the fact that gasoline stocks already have been drawn down more than normal because of shortfalls of imports. Therefore, there will not be as much available in seasonal gasoline stocks to be used for consumption if stocks are to be kept at safe levels. The shortfalls from current imports are approximations of the impact on gasoline production capability from the total import shortfalls for each quarter.

The supply of gasoline in the second and third quarters could be increased by about 150,000 B/D by drawing down gasoline stocks to minimum working levels, but this would increase our vulnerability to a further significant reduction in world oil supplies.

The amount of the shortfall due to reduced oil imports in the coming months could increase above these estimates if refiners find it necessary to shift production away from gasoline production in order to rebuild distillate stocks to safe levels before next winter.

Supplies of unleaded gasoline may be impacted more seriously than leaded gasoline, because stocks of unleaded gasoline already are very low at 66 MMB. Unleaded stocks were only 27 percent of total gasoline stocks, while unleaded gasoline was about 39 percent of gasoline consumption in February.

Distillate Supplies

The shortfalls of distillate fuel oil under the two supply cases would be approximately as follows:

Table 5

(Thousands of Barrels/Day)

	1979			1980
	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar
Base Case				
Shortfall Due to Low Stocks	150	255	0	0
Reduced Current Imports	80	70	120	115
Total Shortfall	230	325	120	115
More Severe Case				
Shortfall Due to Low Stocks	150	255	0	0
Reduced Current Imports	80	150	210	210
Total Shortfall	230	405	210	210

Distillate stocks are at very low levels now, with resulting spot shortages in several areas of the country. With warmer weather, distillate stocks will begin to rebuild for next winter.

The critical objective with distillate is to rebuild stocks to safe levels by next October. Without high stocks, the U.S. would be dangerously vulnerable to a cold winter and a further reduction in world oil supplies. The shortfalls of about 230,000 B/D and 325,000 B/D in the second and third quarters under the Base Case reflect the requirement to rebuild stocks rather than actual shortfalls for use during the summer.

Supplies of Other Products

Supplies of other products also would be short under both supply cases. For all other products, shortfalls would average about 180,000 B/D for the four quarters under the

Base Case. In the More Severe Case the shortfalls would average about 295,000 B/D.

Lower sulfur residual oil could be in particularly short supply, because the higher sulfur content of crude oils which are being produced to substitute for lost Iranian exports makes it more difficult and costly to produce low sulfur residual fuel oil.

Price Impacts

The reduction in OPEC oil production and the related increase in prices will have a substantial affect on the U.S. economy both in the short-term and the long-term.

The average delivered cost of a barrel of imported crude oil to the United States is about $18.00 as a result of the OPEC pricing action on March 27, and the continued surcharges. This represents an increase of about 20 percent since last December. As these higher imported crude oil costs are passed along in petroleum products, it can be expected that gasoline and fuel oil prices will increase by 5 to 6 cents per gallon.

If the U.S. demand for foreign petroleum remains high and continues to grow as it has, the U.S. should anticipate further price increases by the foreign producers, and greater difficulties in acquiring the quantities of oil required.

Summary of the Impacts on the U.S. of the Limited World Oil Supply

The primary immediate impact of the curtailment of world oil supplies on the U.S. oil supply situation has been to reduce industry stocks to unacceptably low levels, impacting oil supplies over the next 6 months to 1 year, even if world oil production remains at current levels.

An important objective must be to rebuild distillate fuel oil stocks during the next 6 months. A reduction in distillate consumption averaging over 270,000 B/D during these 6 months will be necessary if world oil supplies are at the Base Case level. A reduction of over 315,000 B/D would be needed if world oil supplies drop to the More Severe Case level. Alternatively, gasoline production could be reduced to increase distillate production, but this would worsen the gasoline shortfall. Nevertheless, this action may be necessary in order to rebuild distillate stocks to safe levels.

Without any reduction in gasoline production to increase distillate stocks, there will be a need to reduce gasoline use below the projected demand levels to avoid shortages this summer and in the future. Consumption should be reduced by about 225,000 to 250,000 B/D below the projected demand levels during the next 6 months in order to maintain stocks at safe levels, under the Base Case.

These reductions in oil consumption are necessary to offset the loss of oil imports earlier this year, and to live within the constrained world supply of oil in the future. Reductions in consumption also are essential if we are to reduce pressures to increase prices still further.

Attachment 3

CRUDE OIL PRICE DECONTROL

The crude oil pricing proposal has five basic objectives:

A. To provide incentives to increase domestic production. The proposal would:

- Allow all production from marginal wells to receive the upper tier price by the end of 1979.
- Allow newly discovered oil to sell at the world price.
- Implement a program to stimulate tertiary production by allowing producers investing in certain projects to release specified volumes of lower tier oil to the upper tier price as partial reimbursement.
- Allow the upper tier price to rise gradually after January 1, 1980.

B. To bring U.S. domestic crude oil prices to world levels by October 1, 1981.

- The combination of regulatory actions DOE intends to pursue will bring the average cost of all crude oil purchased by the U.S. refiners close to the world price by October 1, 1981.
- The refiner acquisition cost of domestic crude oil will rise from approximately 86 percent of the world price to 96 percent by October 1, 1981.

C. To reduce oil imports.

- By stimulating increased domestic production and inducing additional conservation, this crude oil pricing policy will reduce oil imports by:

	Thousands of Barrels Per Day
1979	60 to 80
1980	180 to 200
1981	370 to 440

D. To minimize the inflationary effects of increases in domestic oil prices.

- All measures to increase crude oil prices will be structured to phase the increases gradually between now and October 1, 1981. This will limit the inflationary impact over time.

E. To dismantle the cumbersome system of price controls and crude oil entitlements.

The measures to move domestic oil prices to world levels will:

- Allow price controls to expire in 1981 without any serious dislocations in the economy.
- Eliminate the need for the cumbersome entitlements system.

Attachment 4

INCREASED PRODUCTION FROM THE NAVAL PETROLEUK RESERVE AT ELK HILLS

I. Description

The Naval Petroleum Reserves are being produced under Maximum Efficient Rate (MER) principles as specified in the NPR Production Act of 1976. The current rate of production at Elk Hills is about 140,000 B/D. Production at the MER entails pumping oil from the various pools at rates which will not cause reservoir damage, thus permitting pressure maintenance and maximum ultimate recovery of all hydrocarbons. Through the drilling of new wells and the development of a water injection system, production would be increased to 160,000 B/D at Elk Hills by the end of 1979.

Resolution of litigation between Chevron and the United States concerning part of Elk Hills production could add another 30,000 B/D to Elk Hills production within 90 days after resolution of the case.

II. Implementation

The DOE is proceeding with drilling new wells, developing a water injection system and expanding the gathering system for the Elk Hills reservoir. This is expected to lead to an increase in production of 20,000 B/D by the end of 1979 and 40,000 to 60,000 B/D by October 1980.

The DOE is working with the Department of Justice to resolve the litigation with Chevron concerning a portion of the Reserve. There is an action pending before the 9th Circuit Court of Appeals to reverse the stay which has caused the 30,000 B/D reservoir to be shut-in.

III. Increased Production Resulting from these Actions
(in thousands of barrels per day)

Incremental Production	2Q'79	3Q'79	4Q'79	1Q'80
Estimate	5	10	20	20

IV. Costs

- Increasing production above the current MER will cost approximately $20 million.

V. Benefits

- Increased Elk Hills production would contribute to reducing U.S. dependence on foreign oil.

Attachment 5

STATE, LOCAL AND PRIVATE INITIATIVES TO REDUCE PETROLEUM USE

I. Description

The Administration requests State and local government leaders to develop programs suited to their areas to reduce oil consumption to help prevent shortages of oil and to reduce upward pressure on prices. Individuals, firms and organizations are requested to participate, to help minimize the economic impacts and inconvenience on any one sector or region of the country. The Department of Energy will assist State and local leaders and organizations in this voluntary conservation effort.

Actions which are requested include the following:

- States have been requested by the President to develop specific targets and implementation plans to reduce gasoline usage in each state. States also have been requested to reduce direct government use of gasoline, and to control temperatures in government buildings, similar to the requirement being placed on Federal agencies.
- All Americans are requested to reduce gasoline consumption, by reducing and consolidating private business trips, increasing the use of carpooling, vanpooling and mass transit, enforcing and obeying the 55 MPH speed limit, and curtailing pleasure driving, motor boating, and flying. The President has requested each individual driver to reduce driving by 15 miles per week; and commercial and industrial firms are requested to assist and encourage the use of carpooling and vanpooling and develop other measures suited to their firms and communities.
- All Americans are requested to reduce the use of distillate and residual heating oil both directly and indirectly (by reducing use of electricity) by controlling thermostat settings at no more than 65° in the heating season and 80° in the cooling season. These standards should be followed in homes, offices, public buildings and commercial and industrial establishments.

II. Implementation

The Department of Energy will undertake a major public awareness information program to encourage maximum cooperation in this conservation effort.

Meetings are being held with State and local groups, to identify voluntary, as well as mandatory, demand restraints that worked in the past. That information is being used to form the basis of communications to Governors and private organizations requesting implementation of previously successful efforts to reduce consumption.

DOE will continue to work with the States, industries, labor unions, trade associations and other organizations, to establish specific energy savings goals and implementation actions.

III. Savings in Consumption of Petroleum Products Resulting from this Measure (in thousands of barrels per day)

	2Q'79	3Q'79	4Q'79	1Q'80
High Estimate				
Fuel Oil	300	280	360	420
Gasoline	390	388	372	362
Total	690	668	732	782
Low Estimate				
Fuel Oil	180	168	216	252
Gasoline	234	233	223	217
Total	414	401	439	469

The high savings figures assume a 5 percent reduction in use of gasoline and fuel oil, and the low savings estimates assume a 3 percent reduction in gasoline and fuel oil use.

For purposes of estimating total petroleum savings, it is assumed that fuel oil savings of about 200,000 to 400,000 B/D will be achieved either through voluntary actions or as a result of the mandatory building temperature control plan. These savings are accounted for under the Building Temperature Controls category in Table A. It also is assumed that the gasoline savings would be near the low estimate, or 200,000 to 250,000 B/D. These savings are accounted for under the category of State, Local and Private Initiatives to Save Gasoline in Table A.

IV. Costs

- The Federal government would incur costs of $500,000 to $1 million for public awareness materials.
- Additional costs may be incurred by State and local governments and the private sector to implement the voluntary plans.

V. Benefits

- There would be little or no reduction in output or income as a result of these actions.
- These actions may avoid the need for mandatory measures, thus minimizing interference with the petroleum market and freedom of choice of energy users.

Attachment 6

NATURAL GAS INITIATIVES

I. Description/Legal Authorities

Utilize the temporarily available natural gas bubble to replace the use of oil by utilities and other major industrial and commercial users.

Section 311(b) of the Natural Gas Policy Act of 1978 provides for sales of available gas by intrastate pipelines to interstate pipelines. In addition, temporary (60-day) emergency sales of natural gas by intrastate to interstate pipelines are allowed under prior Federal Power Commission legislation.

II. Implementation

1. The Secretary of Energy has issued a policy statement emphasizing the need to switch from oil to natural gas on a short-term basis. Some substitution of gas for oil has already taken place in response to the oil shortage in the first quarter.

2. The Secretary has proposed to FERC that it facilitate short-term, direct purchases of gas by industrial or commercial facilities now using oil, particularly distillate oil.

3. FERC is considering a rule providing that natural gas used to replace oil during this emergency will not be considered in determining interstate curtailments or in market classification proceedings. FERC is now accepting comments on the proposed rule and is expected to make a final determination by May 17, 1979.

4. DOE is surveying interstate pipelines and distributors most likely to have surplus deliverability.

5. DOE has implemented a program to facilitate matching deliverable supplies with potential users.

III. Savings in Consumption of Petroleum Products Resulting from this Measure (MB/D)

	2Q'79	3Q'79	4Q'79	1Q'80
High				
Residual/ Distillate	400	400	400	400
Low				
Residual/ Distillate	250	250	250	250

Roughly two-thirds of the oil savings will be residual fuel oil; the other third will be distillate.

Some estimates of the potential to switch to natural gas are higher than the above estimates and indicate that savings of up to 500,000 barrels of oil per day are possible, if every effort is made to use natural gas. DOE will be pursuing these higher targets.

IV. Costs

Under intrastate to interstate sales, high priority users (e.g., home heating) would have to absorb rolled-in increases in rates.

V. Benefits

- o Utilizes existing excess supply of domestic natural gas.
- o Frees distillate and residual fuel oil for replenishment of stocks.
- o Offsets demand for imported fuels/crude oil.
- o May decrease cost for users of oil, particularly distillate, who switch to natural gas.

Attachment 7

ELECTRIC ENERGY TRANSFERS

I. Description/Legal Authorities

Encourage, facilitate and, if necessary, order utilities to transfer electricity from coal and hydro sources to utilities which are now dependent primarily on oil.

Regional Electric Reliability Councils would be used to encourage voluntary energy transfers. Section 202(c) of the Federal Power Act could be used to order specific emergency interconnections and energy transfers if voluntary arrangements fail to achieve desired objectives.

II. Implementation

Major electric utility and power pools are already engaging in large-scale voluntary inter-regional transfers (primarily economy exchanges) which have the direct effect of displacing oil use. Greater levels of voluntary transfers will evolve with increasing oil prices. The clearly stated intention of DOE to exercise emergency authority under Section 202(c), is likely to result in sustaining maximum practicable levels of energy transfers without the need for direct Federal intervention.

Cooperation of State regulatory commissions is necessary to insure that there are no impediments to the import/export of power such as permission to deviate from economic dispatch recovery of purchased-power costs.

In addition, FERC has initiated action on rules relating to tariffs for emergency electric power transfers and fuel conservation tariffs under non-emergency conditions.

In order to determine the effectiveness of the voluntary program, a detailed monitoring program has been established.

III. Savings in Consumption of Petroleum Products Resulting From This Measure (MB/D)

	2Q'79	3Q'79	4Q'79	1Q'80
High				
Residual	174	149	176	174
Distillate	36	25	38	38
TOTAL	210	174	214	212
More Likely				
Residual	85	85	85	85
Distillate	15	15	15	15
TOTAL	100	100	100	100

The high savings estimates are limited duration transfers and cannot be sustained over time. The low estimates represent long-term sustainable transfer levels based on seasonal load variations, normal unit maintenance schedules, forced outage rates and system reliability considerations.

The high estimates include wheeling from and to the following areas:

		Approximate Daily Average over 5 quarters (1000 barrels)		
From	To	Total	Resid.	Distillate
ECAR	Mid Atlantic Region, New York and New England	112.0	95.0	17.0
TVA, ECAR, MAIN	Louisiana-Arkansas	80.0	65.0	15.0
Pacific Northwest	California	4.5	4.0	0.5
Southeast	Florida	4.5	4.0	0.5
All Electricity	Transfers	201.0	168.0	33.0

IV. Costs

- Consumers in importing regions may experience some increases in electric bills under a mandatory transfer program if emergency conditions warrant deviation from economic dispatch. Estimates of increased costs to consumers range from about 0.5 cents to 1 cent per kilowatt hour. Some of this cost may be attributable to existing rate structures which permit charges for transfers in excess of costs.

- Lack of uniform, approved interchange tariffs and state regulatory provisions may lead to large differences in cost impacts to various states and regions.

V. Benefits

- Simple to initiate and monitor; the operational feasibility is very high.

- Relies primarily on established industry procedures to make the most effective use of non-oil fired generation and transmission networks. Government involvement in this project is minimal except for oversight and monitoring effort.

Attachment 8

LEAD PHASEDOWN FOR GASOLINE

I. Description/Legal Authorities

Lead phasedown regulations have been promulgated by EPA for the last seven years to reduce the amount of lead used in leaded gasoline to limit the total amount of lead emitted to the atmosphere. These standards have been established to reduce human exposure to lead.

Current regulations limit the amount of lead in gasoline to 0.8 grams per gallon (gpg), but waivers have been allowed so that the 0.8 standard applies to only about 18 percent of all production. This limitation was scheduled to apply over the next six months to an increasing number of refiners, and on October 1, 1979 all but very small refiners would have been required to limit lead to 0.5 gpg.

Because reducing the lead content of gasoline requires additional volumes of oil in the refining process to produce the same amount of gasoline and reduces the capability of U.S. refiners to produce gasoline, EPA has agreed to act on requests for waivers from the current limit of 0.8 gpg for the next six months and to proceed with an expedited rulemaking to establish the 0.8 gpg requirement on October 1, 1979 rather than the 0.5 gpg limit scheduled. Waiver of the existing requirement will save about 10,000 to 15,000 B/D of crude oil between now and October 1. Phasedown to 0.8 gpg in lieu of 0.5 gpg will avoid crude oil losses of 20,000 to 30,000 B/D after October 1, and avoid the loss of 260,000 to 340,000 B/D of gasoline production capability. The 0.8 gpg standard will protect urban children, those most vulnerable to lead.

II. Implementation

1. EPA will act on requests for waivers of the 0.8 gram limit for refiners which are now subject to the requirement.

2. EPA will proceed with an expedited rulemaking to implement a phasedown to 0.8 gpg in lieu of 0.5 gpg on October 1 1979.

3. The waivers and deferral requirements will be subject to agreement by the refiners to increase unleaded gasoline production to meet the rising needs for this fuel.

III. Savings in Consumption of Petroleum Products Resulting from this Measure (MB/D)

Estimated Savings	2Q'79	3Q'79	4Q'79	1Q'80
Crude Oil Savings	10-15	10-15	(20-30)	(20-30)
Increased Gasoline Production Capability	20-35	20-35	(260-340)	(260-340)

The crude oil savings in the first two quarters would result from reduced refinery processing fuel use. The estimates for the last two quarters represent losses avoided rather than savings from current consumption levels.

The increased gasoline production capability would result from the additional flexibility in refining operations which would be permitted in the absence of the lead phasedown requirement. Increases in the first two quarters could result from waivers of the 0.8 grams per gallon limit for those refineries currently not on waivers from this standard. The gasoline production impacts subsequent to October 1, 1979, are again losses avoided rather than increases from current consumption.

IV. Costs

Would result in a temporary delay in achieving the planned standards for lead in gasoline, but preliminary results of studies indicate that there may be little additional health benefits from a .5 standard rather than a .8 standard.

V. Benefits

- Savings in crude oil will reduce the impact of the world oil shortfall. The avoidance of a major loss in gasoline production capability could help prevent serious gasoline shortages in the summers of 1979 and 1980.

- This action would have no adverse economic impacts.

Attachment 9

EMERGENCY BUILDING TEMPERATURE RESTRICTIONS

I. Description/Legal Authorities

This plan would restrict thermostat settings to 65 degrees for heating purposes, and 80 degrees for cooling purposes in commercial, industrial and public buildings. Legal authorities for development and implementation of this plan are primarily contained in Section 201 and 202 of the Energy Policy and Conservation Act (EPCA) of 1975 (P. L. 94-163).

II. Implementation

Administrative Actions Required:

- The plan was submitted to Congress on March 1, pursuant to EPCA.
- Congress has 60 days within which to consider the measure and approve or disapprove it.
- Pending Congressional approval, DOE will prepare implementing regulations; and will complete pre-implementation activities (such as development of a compliance strategy, exemption procedures, exceptions and appeals procedures, etc.). States have the option and are encouraged to develop alternative plans which achieve the same level of savings as the Federal plan but are better suited to the specific economic conditions of each state.
- Upon Congressional approval, the President plans to inform the Congress of his decision to implement the plan, with a statement of the effective date and manner for exercise of the plan.
- This measure could be implemented in about 2 weeks after a Presidential decision.

III. Savings in Consumption of Petroleum Products Resulting From This Measure (in thousands of barrels per day)

	2Q'79	3Q'79	4Q'79	1Q'80
High				
Residual	25	90	100	95
Distillate	85	260	290	280
Total	110	350	390	375
Conservative				
Residual	15	45	50	40
Distillate	40	130	145	140
Total	55	175	195	180

The high savings estimates are based on a compliance rate of 100 percent. Conservative savings are based on 50 percent compliance. Distillate savings primarily result from reduced peak load electricity generation.

IV. Costs

May adversely affect specific businesses, if not given exemptions, which cannot operate efficiently at prescribed temperatures.

V. Benefits

- This action will have little adverse economic or social impacts.
- It has a relatively quick start-up time.
- A high rate of compliance is expected.

Attachment 10

FEDERAL GOVERNMENT INITIATIVES

I. Description

The President has directed all agencies to reduce energy consumption by 5 percent in response to the shortfall in world oil supplies. The 5 percent target level is taken against April 1978 to April 1979 consumption levels. Coal use is excluded from the total. Switching from oil to natural gas or coal will help satisfy the reduction goal.

In achieving this 5 percent reduction, agencies must reduce gasoline use in Federal vehicles by 10 percent, and set building thermostats at no more than 65° in the heating season and 80° in the cooling season. Agencies have been directed to develop additional initiatives to achieve the full 5 percent reduction.

The Administration is proceeding to charge full commercial rates for employee parking spaces provided by Federal agencies in urban areas. The full rates are to be phased in starting in October.

II. Implementation

Immediate reductions in Federal energy consumption will be achieved as a result of a directive issued by the President. The directive will require all agencies to:

1. Reduce energy use by at least 5 percent.
2. Reduce gasoline use in Federal vehicles by at least 10 percent, and to control building temperatures at 65° in winter and 80° in summer.
3. Reduce all hot water settings to 105 degrees except where required for health and safety.

The full commercial parking rate will be phased in, with one-half the full rate charged starting in October 1979.

III. Savings in Consumption of Petroleum Products Resulting from this Measure (MB/D)

	2Q'79	3Q'79	4Q'79	1Q'80
Petroleum Products	12	16	19	29

Attachment 11

EMERGENCY WEEKEND GASOLINE SALES RESTRICTIONS

I. Description/Legal Authorities

This plan would prohibit sales of gasoline and diesel fuel by retail filling stations during all or a portion of the weekend hours (Friday noon to Sunday midnight). Fuel would be dispensed only to emergency and certain types of commercial vehicles. The development of this plan was undertaken to fulfill requirements of Sections 201 and 202 of the Energy Policy and Conservation Act of 1975 (P.L. 94-163).

If gasoline shortages were severe, full closure from Friday noon until Sunday midnight for one or more weekends of the month would be possible. Closings could be made effective only on Sundays, however.

The President has submitted an Amendment to the plan under which States would be permitted to develop alternatives to the Federal plan. If mandatory sales restrictions are required, States first would be permitted to develop their own plans and submit them to the Department for approval. A State would have 60 days to demonstrate that its alternative plan had achieved the target gasoline savings set for that state.

II. Implementation

Administrative Actions Required:

- This plan was submitted to Congress on March 1, pursuant to EPCA. Congress has 60 days to consider the measure.
- Pending Congressional approval, DOE will complete implementing regulations; and will complete pre-implementation activities. States have the option and are encouraged to develop alternative plans which achieve the same level of savings as the Federal Plan but are better suited to the specific economic conditions of each state.

- The President would determine whether putting the plan into effect is required by a severe energy supply interruption or in order to fulfill U.S. obligations under the international energy program.
- The President would submit this finding to the Congress with a statement of the effective date and manner for exercise of the plan.
- This plan can be implemented in about 2 weeks after a Presidential decision is made.

III. Savings in Consumption of Petroleum Products Resulting From This Measure (in thousands of barrels per day)

	3Q'79	4Q'79	1Q'80
High			
Gasoline	270	235	220
Low			
Gasoline	135	120	110

The "high" savings estimates are based on an assumption of essentially 100 percent compliance, and that none of the savings would be realized in the absence of the measure. The "low" estimates assume approximately 50 percent of "high" savings, because of possible countervailing activities, e.g., increasing inventories by tank-topping and/or increased gasoline use associated with queueing.

IV. Costs

- May increase queueing before and after limitation periods, e.g., Thursdays, Fridays and Mondays.
- May result in filling of car gas tanks and home garage-can storage, both of which could produce reductions in industry inventories and could have safety problems.

- Will adversely impact some segments of the recreational and tourism industries. Potential losses are estimated at 7-8 billion dollars over a nine month period, but the saved petroleum would permit a higher level of economic activity in other sectors of the economy to more than offset those losses.

V. Benefits

- Emphasizes to all Americans the importance of voluntary reductions in gasoline use.
- Would have relatively low administrative and enforcement costs, and could be implemented relatively rapidly.

Attachment 12

ALLOCATION AND PRICE CONTROLS

I. Description/Legal Authorities

The Department of Energy in January 1979 promulgated as final rules: (1) the Standby Mandatory Crude Oil Allocation and Refinery Yield Control Program and (2) the Standby Product Allocation and Price Regulations. The regulations could be put into effect pursuant to Section 4(a) of the Emergency Petroleum Allocation Act (EPAA) P.L. 93-159.

Refiners will be requested to establish individual distillate stock level targets for October 1, 1979, to reach a total distillate primary stock level of 240 MMB. DOE will be prepared to use available standby authorities, including mandatory gasoline allocation, if necessary.

II. Implementation

Both the crude oil and product allocation regulations require a determination by the Administrator of the Economic Regulatory Administration (ERA) that they are necessary to carry out the purposes of the EPAA. Once that determination is made, they can be implemented immediately, although the Department may first want to receive public comment. All or any portion of either or both could be implemented. Implementation would involve:

Crude Oil

1. Using the current Buy/Sell program if only small refiners have serious crude shortages.

2. If the Administrator determines that a few large independent or major refiners are experiencing a serious shortage of crude oil, he can use the current Buy/Sell program to allocate oil to them also.

3. If the Administrator determines that a significant number of large independent and major refiners have shortages, he can maintain the current Buy/Sell program for small refiners and invoke a separate program for large refiners.

4. If a general emergency is declared or if the International Energy Program is triggered, a single allocation program involving all refiners could be put into effect, and crude oil would be allocated to all refiners in accordance with a national allocation fraction.

5. If there is a severe shortage of one product relative to others, ERA could issue orders to refiners requiring them to maximize their yields of the product in short supply.

Petroleum Products

- o The standby product allocation regulations can be implemented selectively or on all products. In the case of products already under controls, they can be substituted for the present controls.
- o Special provisions can be implemented to prevent commercial, industrial or utility customers from receiving their allocations of oil if they can switch to gas, propane or other alternate fuel.
- o If consumption remains high but stocks are being drawn down dangerously, mandatory allocation fractions can be imposed to restrict the available supply and build stocks. This step would likely be taken in advance but in anticipation of serious shortages.

III. Savings in Consumption of Petroleum Products Resulting from this Measure (MB/D)

In general no savings are involved because these controls equitably allocate and price whatever the available supply is. However, the mandatory allocation fraction can cause a short term reduction in consumption to virtually any level desired, and this and other provisions can facilitate programs to switch users from oil to gas or other available fuels. An advantage of using mandatory allocation fractions as a short term demand restraint measure is that it assures that the desired reduction in consumption is achieved.

IV. Costs

- o Distortions caused by the present controls on motor gasoline, propane, butane, and natural gasoline would be continued, together with the existing disincentives to invest in expanded refinery capacity.

- Allocations inevitably result in some inequities because the allocations are based on historical usage rates which cannot accurately reflect current and future needs.

V. Benefits

- Crude oil allocation controls would assure that all refiners have relatively equal access to crude oil and would help prevent competitive inequities at the refinery level.
- Product allocation controls could be used to reduce demand in the short term, by imposing mandatory allocation fractions, and increase inventories for use later if the shortage becomes progressively worse.

DOE/CR-0004

U.S. Department of Energy
FY 1980 Budget to Congress

Budget Highlights

FY 1980 Budget Highlights

The Department of Energy (DOE) was established on October 1, 1977 to bring together the various energy activities dispersed throughout the Federal government and to provide unified leadership to the Nation's energy policies and programs. During its first year of operation, the Department has developed both a national energy program and a unified organization to oversee its execution.

Accomplishments during this initial year of operation include:

- passage in partnership with the Congress of a National Energy Act aimed at reducing our dependence on foreign sources of energy through incentives and regulation to achieve fuel switching, conservation, and increased use of renewable energy sources.
- evaluation of the various programs and projects inherited from DOE's predecessor agencies to assess their interrelationship, balance and effectiveness in achieving the Nation's energy objectives.

It is within this context of program assessment, balancing and integration that the Department's FY 1980 Budget has been formulated.

The FY 1980 budget totals $8.4 billion in budget authority and $10.2 billion in budget outlays. A distribution of the budget by major programs categories is presented below:

	Budget Authority (In Millions)	
	FY 1979	FY 1980
Energy Technology	$ 3,625	$ 3,583
Basic Sciences	431	474
Conservation	671	555
Regulation and Information	276	323
Defense Activities	2,685	3,022
Government-Owned Operations	248	149
Policy and Management	258	308
Less: Supplementals and Other Adjustments	-403	-
Subtotal	$ 7,791	8,415
Strategic Petroleum Reserve	3,008	8
TOTAL DOE FUNDING	$10,799	$ 8,423

At first glance, it appears that budget authority is significantly reduced when compared to the FY 1979 level. However, this is accounted for by the fact that a major portion of the $3.0 billion provided for the Strategic Petroleum Reserve (SPR) in FY 1979 will remain available in FY 1980. As a result, virtually no additional funding is being requested for this program. Setting the SPR funding aside, the Department's FY 1980 budget request reflects an increase of eight percent in budget authority and seven percent in budget outlays when compared to FY 1979.

It is important to note that while the Department's FY 1980 budget shows relatively modest growth across the board, it also reflects significant program initiatives, realignments and internal trade-offs. These include:

- a major reorientation in the uranium enrichment program to bring production and stockpile levels in line with near-term reductions in demand, saving in excess of $600 million in FY 1980.
- a redirection of near-term conservation and solar applications programs to bring them in balance with the tax credits and other incentives included in the National Energy Act.
- a significant increase in funding to develop technology to manage safely both commercial and defense generated nuclear wastes.
- a realignment of the fossil energy development program to deemphasize large single technology demonstration facilities and to focus funding on selected, most promising technologies.
- additional emphasis on environmental assessment of emerging energy technologies at each stage of development.
- a thorough assessment of the energy technology development programs to ensure that adequate funding has been made available to pursue the basic research necessary to continued technological advances.
- a reorientation of the Department's regulatory programs toward implementation of the National Energy Act while phasing out some compliance activities.
- a refocusing of the energy information program to strengthen data validation, reduce the reporting burden associated with existing data, and undertake new systems in support of the National Energy Act.

The effect of these activities has been to allow the Department to maintain its continuing requirements and meet the funding initiatives resulting from the National Energy Act and other high priority concerns within a modest growth in financial resources. While accepting the additional workload created by the National Energy Act, the Department's manpower has been reduced from 19,100 positions at the time of its establishment to 19,038 at the end of FY 1980.

A discussion of the FY 1980 activities to be undertaken in each major program area is provided in the sections that follow.

ENERGY TECHNOLOGY DEVELOPMENT AND DEPLOYMENT

One of the primary responsibilities of the Department of Energy is to develop new and improved energy technologies and to undertake programs to ensure that those ready technologies effectively penetrate the marketplace. Programs aimed toward this objective include:

- research and development on new technologies to utilize both finite and inexhaustible energy sources.
- improvement in the efficiency and acceptability of existing technologies.
- removal of the environmental, economic and institutional barriers to entry of these technologies into the marketplace.
- characterization and assessment of the availability of various energy resources.

FY 1980 funding for technology development programs totals $3.6 billion in budget authority.

	Budget Authority (In Millions)	
	FY 1979	FY 1980
Fossil Energy	$ 791	$ 796
Solar Energy	528	597
Geothermal	130	111
Hydroelectric	29	18
Magnetic Fusion	356	364
Nuclear Fission	1,204	1,037
Environment	245	278
Basic Energy Research	220	276
Other Technology Programs	122	106
TOTAL	$3,625	$3,583

Increases are provided for solar technology development, environmental research and development, the management of commercial nuclear wastes and the storage of spent fuel from the Nation's light water reactors, and the pursuit of the basic sciences underlying all energy technology development.

FOSSIL ENERGY

The Department's fossil energy programs are directed toward the development and deployment of technologies which will permit the Nation to shift its energy consumption profile away from dependence on oil toward more use of the plentiful domestic fossil resources of coal, secondary and tertiary oil, oil shale and unconventional gas.

The FY 1980 budget provides a total of $796 million for fossil energy development programs, essentially the same as the level of funding provided in FY 1979. However, within the fossil programs, there has been substantial reorientation during the past year.

	Budget Authority (In Millions)	
	FY 1979	FY 1980
Research and Development		
Coal	$ 681	$ 663
Petroleum	108	57
Gas (including Geopressured)	62	64
Less: General Reduction	-63	-
Subtotal	$ 788	$ 784
Other Fossil Programs		
Coal Utilization and Supply Projects	-	4
Petroleum Development Projects	3	8
Subtotal	$ 3	$ 12
TOTAL FOSSIL ENERGY	$ 791	$ 796

Coal

Funding requested for the coal program in FY 1980 totals $663 million, representing a slight reduction from the FY 1979 level. However, during the past year the Department has reassessed its various coal conversion, combustion and clean-up activities to become more selective with regard to the number of technologies receiving direct Federal support.

In order to support required and voluntary conversion to coal, a major acceleration is proposed in the development of flue gas desulfurization technology and other environmental control systems. Funding for this activity increases from $7 million to $43 million in FY 1980.

Selected coal conversion technologies continue to be developed through joint Federal/industry cost-shared pilot and demonstration facilities. These include:

- construction of a facility to demonstrate either the liquid or solid solvent refined coal process.
- the completion of construction and initial operation of the H-coal liquefaction pilot plant in Catlettsburg, Kentucky ($35 million).
- completion of construction on the donor solvent liquefaction pilot plant at Baytown, Texas ($30 million).
- detailed design and construction of a plant to demonstrate an advanced high-Btu gasification technology ($55 million).

The FY 1980 budget also provides $57 million to continue the development of atmospheric and pressurized fluidized bed combustion systems capable of burning high-sulfur coals in an environmentally acceptable manner. A new initiative is proposed to begin four industrial atmospheric fluidized beds in the most energy intensive industries.

A total of $138 million is provided to continue research and development on technologies to increase energy conversion efficiency, including advanced turbines, cogeneration systems, fuel cells and magnetohydrodynamics.

Finally, $51 million will be used to support basic research and development of more advanced coal conversion and combustion technologies.

Coal commercialization activities require $4.5 million in FY 1980 and include market analyses, barrier assessment, and preparation of commercialization plans for low/medium-Btu gasification, liquefaction, direct combustion and coal supply.

Petroleum

Reliance on private sector efforts to commercialize near-term enhanced oil recovery and oil shale technologies is reflected in the reduction of funding for petroleum research and development to $57 million in FY 1980. The Department's emphasis will shift to longer-range technology development projects.

Enhanced oil recovery activities funded in FY 1980 will focus on steam and CO_2 injection field tests and two micellar polymer pilot projects. With regard to oil shale, both modified and horizontal in-situ projects will be continued.

In order to support commercialization of these technologies, the Department is requesting a total of $8 million in FY 1980 to:

- develop an oil shale marketing and transportation strategy.
- provide socioeconomic impact planning and assistance, aiding states in the streamlining of permitting and licensing requirements.
- monitor enhanced oil recovery commercialization activities.

Gas

The FY 1980 budget includes $64 million to define, characterize and develop technologies to tap the Nation's unconventional gas resources, including Devonian shales, Western tight sands and geopressured resources. An accurate understanding of this resource is essential to the development of energy policy decisions. Specific activities include:

- the completion of drilling, stimulation and production of over 30 wells in Devonian shale.
- drilling of five new geopressured wells and continued testing of existing wells to measure methane, heat and kinetic energy content.

SOLAR ENERGY

The Department is responsible for solar technology development and applications programs aimed toward increasing the contribution made by solar energy in meeting the Nation's total energy requirements. Recent estimates calculated by the President's Solar Domestic Policy Review indicate that present solar energy trends may supply as much as 13 percent of projected U.S. energy demand by the turn of the century.

The Department's FY 1980 budget provides $597 million for development and application of the various solar technologies, a 13 percent increase over the amended FY 1979 level.

	Budget Authority (In Millions) FY 1979	FY 1980
Solar Technology	$ 315	$ 333
Biomass	44	58
Solar Applications	169	156
TOTAL DOE DIRECT SOLAR FUNDING	$ 528	$ 597

In addition to these amounts, $31 million in FY 1979 and $49 million in FY 1980 is provided for solar-related activities in generic areas such as environment and basic research. With these crosscutting areas factored in, DOE solar funding totals $559 million in FY 1979 and $646 million in FY 1980. These activities coupled with the National Energy Act tax credits provide a balanced solar program for both near and long-term development of this renewable energy source. For a detailed analysis of solar funding government-wide, see page 24.

Specific solar and biomass technology development activities funded in FY 1980 include:

- continued construction of the 10 MW solar thermal central receiver at Barstow, California ($37 million).
- advanced research in novel photovoltaic materials and systems with high-risk, high-potential payoff ($47 million).
- testing of the MOD-1 wind machine and construction of the MOD-2 megawatt scale machine ($17 million).
- completion of the ocean thermal energy conversion test platform and development and testing of related components ($23 million).
- detailed design of an integrated biomass utilization system which includes collection, transportation and conversion of biomass into medium-Btu fuel gas.

Solar Applications programs deal primarily with the removal of economic and institutional barriers to near-term applications of solar energy. Major program elements in FY 1980 include:

- systems development and engineering for passive solar applications, agricultural and industrial process heat and active heating and cooling systems ($47 million).

- demonstration activities in residential, commercial and Federal buildings, and agricultural and industrial process heat ($73 million).

- solar commercialization activities including barrier assessment, market development, training programs and the preparation of commercialization plans for solar hot water, passive solar and wind ($32 million).

GEOTHERMAL

The FY 1980 budget request of $111 million includes $105 million to stimulate the development of hydrothermal and hot dry rock resources. This represents a decrease of $25 million from the FY 1979 program level reflecting the maturation of hydrothermal technology development.[1/]

Activities to be pursued in FY 1980 include:

- initiation of construction of a 50 MW demonstration plant at Valles Caldera, New Mexico to demonstrate electric power generation from liquid dominated hydrothermal resources ($21 million).

- assessment of low and moderate temperature resources for direct heat applications in cooperation with 28 states.

- continuation of the national hot dry rock resource definition studies in cooperation with the U.S. Geological Service.

- development of technology to reduce the cost of geothermal wells by 25 percent in 1982 and 50 percent in 1986.

In addition to the research, development and demonstration programs discussed above, the FY 1980 budget includes $6 million in support of the Geothermal Resources Development Fund to guarantee an additional $50 million in loans, bringing the total loan guarantee authority under this program to $350 million.

HYDROELECTRIC

The FY 1980 budget requests $18 million to encourage commercial development of low-head hydroelectric power resources at existing dam sites and establish its commercial viability for electric power generation and direct mechanical use. Specifically, FY 1980 funds will be used to:

[1/] Funding for geopressured resources development has been discussed in the Fossil Energy section.

- continue Federal cost sharing of ongoing demonstration projects ($4 million)

- provide feasibility study loans ($10 million).

- conduct an outreach program to provide regional commercialization assistance ($2 million).

MAGNETIC FUSION

Funding of $364 million is provided in FY 1980 to continue development of fusion technology for the generation of electricity in a safe, economic and environmentally acceptable manner. The program strategy is to proceed systematically toward the development of a sound physics, engineering and technological foundation needed for the design, construction and operation of more complex experiments and facilities. Progress, as measured by improvements in plasma density, temperature and confinement time, has been most encouraging.

Activities in FY 1980 include continued construction of:

- major physics scaling experiments, including the Tokamak Fusion Test Reactor ($30 million) and the Mirror Fusion Test Facility ($33 million).

- the Fusion Materials Irradiation Test Facility which will provide the necessary testing capability for materials development and generation of engineering data.

In addition, other tokamak and mirror experimental devices will be operated to continue development of a strong scientific base for the eventual design of a fusion engineering test facility. Finally, the FY 1980 funding level will provide for the assessment and development of alternate fusion concepts.

NUCLEAR FISSION

The nuclear fission programs undertaken by the Department are oriented toward the development of nuclear power as an economic and environmentally acceptable source of electric power generation, while supporting the Nation's non-proliferation policy. FY 1980 funding for nuclear fission activities totals $1.0 billion, in seven distinct yet interrelated programs as described below:

	Budget Authority (In Millions) FY 1979	Budget Authority (In Millions) FY 1980
Uranium Resource Assessment	$ 73	$ 84
Converter Reactor Systems	122	104
Breeder Reactor Systems	742	590
Advanced Nuclear Systems	55	40
Commercial Waste Management	191	199
Spent Fuel Storage	11	20
Light Water Reactor Facilities	10	-
TOTAL NUCLEAR FISSION	$1,204	$1,037

In addition, the Administration is proposing legislation to provide $300 million in borrowing authority to establish a Spent Fuel Storage fund.

The Uranium Resource Assessment program is funded at $84 million in FY 1980 to continue drilling and evaluation activities to determine the quantity and availability of uranium ore resources in the United States. Completion of this effort is critical to future nuclear policy decisions.

Research and development on converter reactors totals $104 million in FY 1980. The program is focused on:

- increasing the safety and efficiency of light water reactors through improved fuel utilization concepts and reduced occupational radiation.

- developing the technology necessary to reduce proliferation risks in research and power reactors.

- developing proliferation-resistant fuels and assisting the Federal Republic of Germany in the development of the direct cycle high temperature gas cooled reactor.

The Converter Reactor Systems program also includes $55 million to continue development of advanced laser isotope separation as an economic process to strip low assay uranium tails and thus further extend the uranium resource base.

In FY 1980, $590 million is provided for Breeder technologies. This funding level will maintain the Administration's commitment to a strong liquid metal fast breeder base research and development program, including full power demonstration of the Fast Flux Test Facility in Richland, Washington. Total Federal funding will be $504 million for the Liquid Metal Fast Breeder Reactor. Development will also continue on the Water Cooled Breeder and Gas Cooled Breeder concepts at essentially the FY 1979 level of effort. Finally, fuel cycle research and development on a proliferation-resistant fuel recycle system for breeder reactor applications will be pursued.

Advanced Nuclear Systems funding totals $40 million in FY 1980 to provide hardware and software support to NASA spacecraft launches scheduled in the early 1980's and continue technology development of reactor-powered space systems. Modest continued support of the International Nuclear Fuel Cycle Evaluation and Non-Proliferation Alternative Systems Assessment Program is also included in this category.

The FY 1980 budget includes $199 million for a major emphasis on the commercial waste management program to ensure safe handling and eventual terminal storage of radioactive wastes generated by civilian power reactors. Consistent with the Interagency Review Group (IRG) recommendations to the President, efforts to evaluate various geologic environments for potential terminal isolation repository sites have been significantly expanded, especially in non-salt media. In addition, construction work will begin on a multi-purpose test facility for in-situ testing of basalt as a medium at the Department's Hanford site.[1/]

The Spent Fuel Storage program, funded at $20 million in FY 1980 provides the technical and operational support of the President's announcement of October 18, 1977, of the Government's commitment to provide interim storage for commercially generated spent nuclear fuel. Separate legislation is being proposed to ensure the availability of an away from reactor storage facility by 1983 and provide for the prepayment of a spent fuel charge by the commercial users. Borrowing authority of $300 million will be requested in the legislation for the construction of the facility, with FY 1980 revenue collections estimated at $100 million.

ENVIRONMENT

The Department's environmental program is designed to ensure that the identification and evaluation of environmental impacts is incorporated in the formulation and implementation of energy technology development and deployment activities. Potential environmental, health and safety concerns are identified early in the development phase, and adequate mitigation processes or controls are determined through research. In successive phases, the adequacy of these controls is monitored and modifications are made as required.

The Department is also responsible for restoring the environmental quality and assuring public health and safety at radioactive contaminated DOE, Atomic Energy Commission/Manhattan Engineer District facilities and inactive uranium mill tailings sites.

[1/] Additional information regarding the Department's Defense Waste Management activities can be found on page 24.

The FY 1980 request for environmental programs is $278 million, a 13 percent increase over FY 1979 as described below:

	Budget Authority (In Millions) FY 1979	Budget Authority (In Millions) FY 1980
Overview and Assessment	$ 52	$ 61
Biomedical and Environmental Research	158	172
Decontamination and Decommissioning	25	33
Program Direction	10	12
TOTAL	$ 245	$ 278

The purpose of the Overview and Assessment program is to ensure that adequate emphasis is placed on environmental concerns during the formulation and implementation of energy technology decisions. In FY 1980, $61 million is requested for this activity. Additional resources are provided to:

- expand the liquified fuels safety assessment program and initiate scale model effects experiments.
- place additional emphasis on environmental assessment of emerging technologies.
- expand efforts to assure the incorporation of National Environmental Policy Act requirements in energy technology development programs.

FY 1980 funding of $172 million is requested for Biomedical and Environmental Research, an increase of $14 million over FY 1979. Significant new efforts include:

- additional site and process specific studies on coal combustion and conversion.
- expansion of research and assessment studies on the effects of increasing carbon dioxide in the atmosphere.
- initiation of an integrated assessment of the health and environmental risks of diesel engine emissions.
- expansion of studies to determine the effects of low-level radiation on humans and late effects in experimental animals.

Decontamination and decommissioning activities are funded at $33 million in FY 1980, an increase of $8 million over FY 1979. Emphasis is being placed on:

- remedial action at inactive uranium mill tailings sites.
- initiation of major disposition projects at several former Atomic Energy Commission/Manhattan Engineer District facilities.

BASIC ENERGY RESEARCH

The Department's basic energy research programs encompass those activities aimed toward the development of a strong technology base to underpin the development of energy technologies to meet the Nation's increasing energy requirements. The FY 1980 budget includes $276 million for basic energy research programs, an increase of $56 million or 25 percent over FY 1979, demonstrating the Department's concern with enhancing its research and development base.

	Budget Authority (In Millions)	
	FY 1979	FY 1980
Basic Energy Sciences	$ 208	$ 253
Technical Assessment Projects	7	12
University Research Projects	3	9
Technical Program & Policy Analysis	2	2
TOTAL BASIC ENERGY RESEARCH	$ 220	$ 276

The Basic Energy Sciences program is directed toward obtaining fundamental knowledge of the physical and biological sciences, engineering and mathematics as they relate to energy production, conversion and conservation. In FY 1980, the requested funding of $253 million will strengthen the research base needed to meet long-term energy needs. More specifically, initiatives will be undertaken to:

- increase the emphasis placed on gaining a better understanding of the chemical behavior of radioactive nuclear waste materials to further our efforts to manage these materials in the long term.
- investigate advanced solar concepts through a better understanding of materials and processes related to solar technologies.

- further expand research in the engineering, mathematical and geosciences.
- improve the opportunities available to university researchers to contribute to energy-related problems.

Also, construction will be initiated on a Chemical Sciences Building addition at Lawrence Berkeley Laboratory to provide for catalysis research.

Technical Assessment Projects will be continued at a level of $3 million in FY 1980. This program provides the Department with the capability for independent and vigorous assessment of its technology development efforts to ensure against gaps or duplication. Also, included in this activity is $8 million to complete the evaluation of the Solar Powered Satellite concept.

University Research support is being increased from $3 million to $9 million in FY 1980. This increase is related primarily to the initiation of university coal research laboratories to conduct research on coal characterization and utilization specific to a region.

OTHER TECHNOLOGY PROGRAMS

Funding for other technology programs, which consists primarily of Electric Energy Systems and Energy Storage Systems, totals $106 million. Major activities to be pursued in FY 1980 include:

- integration of new energy technologies such as wind and solar photovoltaics into the electric grid system.
- research on the effect of electric fields on biological processes.
- continued development of commercial technology for low-cost, long-life, and high performance batteries.
- development of acquifer storage and other thermal storage technologies for solar heating and cooling, solar thermal power, and industrial waste heat recovery.

BASIC SCIENCES

The purpose of the Basic Science programs is to pursue fundamental knowledge in the physical and life sciences in order to gain a deeper understanding of the behavior of matter through an integrated theoretical and experimental program. Basic science programs are not specific to any particular energy technology. Rather through specific investigations they are expected to yield long term scientific and technological breakthroughs.

The FY 1980 request for Basic Science totals $474 million, an increase of $43 million over FY 1979.

	Budget Authority (In Millions) FY 1979	Budget Authority (In Millions) FY 1980
Life Sciences Research and Biomedical Applications	$ 41	$ 42
High Energy Physics	297	327
Nuclear Physics	93	105
TOTAL BASIC SCIENCES	$ 431	$ 474

LIFE SCIENCES RESEARCH AND BIOMEDICAL APPLICATIONS

In FY 1980, the Life Sciences Research and Biomedical Applications program will be funded at $42 million to continue research on the interaction of physical and chemical agents with living organisms. Research and development in new applications of radiation and radioisotopes for the diagnosis and treatment of human disease will be undertaken. A major emphasis also will be placed on genetic studies to expand our knowledge of the damage to macromolecular materials in the cell nucleus caused by energy related pollutants.

HIGH ENERGY PHYSICS

The FY 1980 request for High Energy Physics totals $327 million, a 10 percent increase over FY 1979. Major activities in FY 1980 include:

- the first full year of operation of the new Positron-Electron Project of the Stanford Linear Accelerator Center which will produce colliding electron-positron beams at the highest energy levels to date, thus permitting research not possible elsewhere ($14 million).
- continued construction of the Intersecting Storage Accelerator at Brookhaven National Laboratory ($45 million).
- construction of the Energy Saver project at FERMILAB, with initial experimental use scheduled in FY 1981 ($20 million).

NUCLEAR PHYSICS

The FY 1980 request of $105 million represents a 13 percent increase from the FY 1979 level. This funding will permit:

- continued experimental activity in medium energy and heavy ion nuclear research.
- addition to the Clinton P. Anderson Meson Physics Facility and the Bates Electron Linear Acceleration ($4 million).
- design and long lead procurement for the National Superconducting Cyclotron Laboratory at Michigan State University ($6 million).

CONSERVATION

The Department's Conservation programs are designed to reduce the growth of energy demand by improving energy use efficiency through technology development, grant programs and public education. These key activities are now coupled with the tax credits and regulatory provisions of the National Energy Act to provide a comprehensive approach to reducing energy consumption.

	Budget Authority (In Millions)	
	FY 1979	FY 1980
Research and Development		
Buildings and Community Systems	$ 86	$ 86
Industrial	40	42
Transportation	99	99
SUBTOTAL	$ 225	$ 227
Grant Programs		
State and Local	$ 333	$ 206
State Energy Management and Planning	83*	110
Conservation Multi-Sector	30	12
SUBTOTAL	$ 446	$ 328
TOTAL CONSERVATION	$ 671	$ 555

Although budget authority for the Department's Conservation programs decreases in FY 1980, it should be noted that this decrease is primarily related to the slowed pace of the state and local grant programs due to the delayed passage of the National Energy Act. Carryover funding is available to keep these programs at an adequate funding level in FY 1980. Budget outlays for the Department's Conservation programs continue to show rapid growth from $505 million in FY 1979 to $660 million in FY 1980.

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* This reflects a comparability adjustment for FY 1979 composed of EPCA, ECPA, and Energy Extension Service (grant programs) which will be merged into SEMP in FY 1980.

RESEARCH AND DEVELOPMENT

Conservation research and development activities are designed to provide a better understanding of the common technical problems in energy conservation. These activities also assist the private sector in the development of energy saving technologies in selected cases when a high potential for energy savings is associated with significant technical risks and long-lead time for implementation. The FY 1980 budget includes $227 million for conservation research and development activities in the building and community systems, industrial and transportation sectors. Research and development expenditures level out in FY 1980 since they are now coupled with the anticipated impact of tax incentives to conservation in the National Energy Act.

The FY 1980 budget provides $86 million for the Buildings and Community Systems program. The purpose of this program is to increase energy efficiency by developing options for fuel substitution, as well as technologies which decrease residential and commercial energy requirements. Activities planned in FY 1980 include:

- research and development on the efficient use of energy in residential and commercial buildings.
- development of technical and training materials to refine the Building Energy Performance Standards program.
- development of minimum efficiency standards for major home appliances.
- technical assistance to electric and gas utilities to provide insulation services to residential customers.
- development of technological options to convert urban waste to usable energy.

FY 1980 funding for conservation activities in the industrial sector total $42 million, a slight increase over FY 1979. This program is focused on the development and introduction into industry of high-risk, high-potential energy saving measures through Federal cost sharing. FY 1980 activities include:

- waste energy reduction through combustion efficiency, recuperators and industrial heat pumps.

- facilitating the introduction of process efficiency improvements in the most energy intensive industries, i.e., steel, aluminum, paper and textiles.

- implementation of activities mandated by the National Energy Act such as study of the energy related effects of the second law of thermodynamics and the definition of equipment which qualifies for additional tax credits.

The FY 1980 budget provides $99 million to pursue conservation research and development in the transportation sector, which now consumes one-third of all energy in the United States and over half of all petroleum. Research and development activities in FY 1980 focus on:

- advanced heat engines such as turbines and the Stirling engine.

- electric and hybrid vehicle development including the purchase of 700 demonstration vehicles.

- the utilization of alternative fuels such as alcohol-gasoline blends.

GRANT PROGRAMS

The FY 1980 budget requests $328 million in budget authority and $423 million in budget outlays to provide grants to improve energy conservation at the state and local level. The objective of these programs is to:

- support national energy goals through energy conservation programs in which State and local governments play a central planning and implementation role.

- promote feedback of ideas, research and development needs and innovations to the Federal Government.

- disseminate information regarding existing and new technologies with significant potential for energy conservation.

Major FY 1980 grant activities include:

- continuation of the weatherization program which provides assistance to low income persons, especially the elderly and handicapped, to conserve energy in their homes ($199 million).

- establishment of the State Energy Management and Planning (SEMP) program which restructures several existing grant activities including the EPCA/ECPA and the Energy Extension Service ($110 million).

In FY 1980, no additional grant funding is requested for the Schools and Hospitals program since sufficient carryover funds will be available from prior years to continue that program at the proper pace. Also, funding for the local Government Buildings program is completed through a FY 1979 supplemental request. This essentially accounts for the overall reduction in grant funding in FY 1980.

REGULATION

The regulatory activities assigned to the Department are the responsibility of the Federal Energy Regulatory Commission and the Economic Regulatory Administration. In FY 1980, funding for these organizations totals $234 million, a $37 million increase over the amended FY 1979 level. The majority of this increase is related to implementation of the National Energy Act legislation.

ECONOMIC REGULATORY ADMINISTRATION

The FY 1980 request for the Economic Regulatory Administration (ERA) and the Office of Hearings and Appeals is $160 million, a $27 million increase over the amended FY 1979 level. The ERA administers programs to:

- prohibit the use of scarce fuel, especially oil in new powerplants and major industrial installations and to convert them to coal or other abundant fuels.
- control imports and exports of oil, gas and electricity.
- achieve equitable pricing and allocation of crude oil and petroleum products.
- support adoption of utility rate structures which foster conservation.
- prepare plans to protect the country in the event of an energy emergency.

Major activities in FY 1980 include: implementation of the National Energy Act legislation, primarily the Powerplant and Industrial Fuel Use Act and the Public Utilities Regulatory Policies Act; efforts to continue to uncover and remedy petroleum pricing violations; and further development of procedural and structural modifications to expedite the regulatory process.

FEDERAL ENERGY REGULATORY COMMISSION

With the exception of certain intrastate activities, the Federal Energy Regulatory Commission (FERC) has direct or indirect jurisdiction over all facets relating to the transmission and sale of electric power, gas and oil production. In addition, the Commission is responsible for implementation of the Natural Gas Policy Act, and many portions of the Public Utility Regulatory Policies Act and the Powerplant and Industrial Fuel Use Act. These three Acts are part of the comprehensive National Energy Act.

To carry out these activities, the FERC is requesting $74 million in FY 1980, which represents a $10 million increase over FY 1979.

	Budget Authority (In Millions)	
	FY 1979	FY 1980
Gas Regulation	$ 34	$ 41
Hydro Regulation	11	13
Oil Regulation	5	5
Multi-Resource Regulation	14	15
TOTAL FERC	$ 64	$ 74

Major activities in FY 1980 focus on:

- continued implementation of the National Gas Policy Act by developing regulations to establish and enforce policies for natural gas pricing, production, transmission, and distribution.
- fulfilling the mandates of the Public Utility Regulatory Policies Act to collect information from electric utilities on costs of service and to assume authority for ordering electric power wheeling and interconnections.
- implementation of an accelerated dam safety inspection program.
- operation of an effective enforcement program to assure compliance with Commission rules and regulations.
- management improvements to expedite processing of filings and improve internal procedures to minimize case backlogs.
- further efforts to minimize the reporting burden on individuals and companies resulting from Commission regulations.

ENERGY INFORMATION

The Department's energy information activities are performed by the Energy Information Administration which is responsible for:

- developing and maintaining a comprehensive and reliable base of energy information and analytical capability within the Department of Energy to assist legislative, executive and private decision-makers in planning the Nation's energy programs at the Federal, state and local levels.
- collecting and disseminating information on energy supply and consumption.

The FY 1980 funding requested for this activity is $89 million, an increase of about 12 percent over the amended FY 1979 level of $79 million.

	Budget Authority (In Millions)	
	FY 1979	FY 1980
Energy Applied Analysis	$ 14	$ 14
Collection, Production, and Dissemination	44	47
Data Validation	11	16
Data Information Services	10	12
TOTAL ENERGY INFORMATION	$ 79	$ 89

Activities receiving increased emphasis include the validation of energy information data and data gathering responsibilities in support of the Natural Gas Policy Act. These latter activities include:

- monthly natural gas usage categorized by sector for curtailment planning and determining incremental pricing impacts.
- monthly natural gas storage injections and withdrawals.
- natural gas and alternative fuel acquisition costs.

ATOMIC ENERGY DEFENSE ACTIVITIES

The Department is responsible for atomic energy defense-related programs which encompass research, development and production activities in support of national security requirements. The FY 1980 request for defense-related programs totals $3.0 billion, which represents a $337 million increase over the amended FY 1979 level of $2.7 billion.

	Budget Authority (In Millions)	
	FY 1979	FY 1980
Inertial Confinement Fusion	$ 144	$ 146
Naval Reactors Development	297	278
Weapons Activities	1,468	1,659
Verification and Control Technology	30	38
Materials Production	443	482
Defense Waste Management	257	372
Nuclear Materials Security and Safeguards	46	47
TOTAL ATOMIC ENERGY DEFENSE ACTIVITIES	$2,685	$3,022

INERTIAL CONFINEMENT FUSION

The FY 1980 request of $146 million is essentially equal to the FY 1979 level and provides for continuation of research and development efforts to determine the feasibility of laser and electron beam initiated fusion through inertial confinement. In FY 1980 increased emphasis will be placed on:

- target development and systems studies.
- fusion theory and experimental efforts using newly available facilities such as the Electron Beam Fusion Accelerator at the Sandia Laboratory.

Also, construction will continue on the NOVA high energy laser facility at Lawrence Livermore Laboratory ($15 million) and the ANTARES high energy laser facility at Los Alamos Scientific Laboratory ($12 million).

NAVAL REACTORS DEVELOPMENT

Funding of $278 million is requested in FY 1980, which represents a decrease of $19 million from the previous year. The decrease in funding results from reduced subcontract activity in prototype refueling, modifications and core procurements. The FY 1980 request will provide for:

- continued improvements to existing submarine and surface ship reactor core and plant technology
- support to operating fleet submarines and surface ships.
- operation, testing and training at land based prototypes.
- a new construction project to upgrade fluids and corrosion test facilities to support development of longer life component designs.

WEAPONS ACTIVITIES

The FY 1980 request for weapons activities amounts to $1.7 billion as' described below:

	Budget Authority (In Millions)	
	FY 1979	FY 1980
Research and Development	$ 477	$ 544
Testing	225	220
Production and Surveillance	733	858
Program Direction	33	37
TOTAL WEAPONS ACTIVITIES	$1,468	$1,659

The increased funding in FY 1980 is primarily related to:

- initiation of a multi-year restoration effort to upgrade deteriorating equipment and facilities throughout the weapons complex ($81 million).
- production and delivery to the stockpile of new nuclear weapons to meet commitments to the DOD.

Nuclear weapons research, development and testing will continue with weapons laboratories manpower levels essentially unchanged from FY 1979.

VERIFICATION AND CONTROL TECHNOLOGY

The FY 1980 budget request of $38 million provides for development of the technology base and system production capacity necessary to sustain the Nation's ability to verify and monitor nuclear test ban agreements. The FY 1980 request continues a major focus on test ban related activities, including:

- demonstration of the feasibility of a regional seismic detection system.
- five developmental National Seismic Stations.
- satellite-borne instrumentation for detecting nuclear explosions in the atmosphere.

MATERIALS PRODUCTION

This activity provides for the production of special nuclear materials, principally plutonium, to meet national defense requirements and the reprocessing of naval reactor fuels. The FY 1980 request for this activity is $482 million, an increase of $40 million over FY 1979. Provided for is:

- operation at reduced capacity of three production reactors at Savannah River, N-Reactor at Richland, and associated support facilities.
- operation of the Idaho Chemical Processing Plant to reprocess naval fuels.

The FY 1980 request also permits continued construction of the Fluorinel reprocessing facility at Idaho ($53 million) and an environmental and security project at Richland ($17 million).

DEFENSE WASTE MANAGEMENT

A major emphasis is being placed on the defense waste management program in FY 1980. The request for this activity totals $372 million, an increase of $115 million or 45 percent over FY 1979. The Department's defense waste management program incorporates three major activities:

- the safe handling and disposal of DOE low-level and airborne radioactive wastes.
- the interim storage of DOE transuranic and high-level waste.
- the development and demonstration of technologies to implement long-term disposal options.

Specifically, in FY 1980 the transfer of high-level waste from older waste tanks to new improved tanks will be accelerated and the decontamination, decommissioning and transportation programs will receive increased emphasis. Consistent with the Interagency Review Group (IRG) recommendations to the President, the effort to develop alternative waste forms for high level waste immobilization will be strenghtened. Engineering design will begin on the first immobilization facilities for high-level and transuranic waste. Finally, funds are requested for design, long lead procurement and land acquisition for the Waste Isolation Pilot Plant in southeastern New Mexico ($55 million).

NUCLEAR MATERIALS SECURITY AND SAFEGUARDS

The FY 1980 request of $47 million provides for the continued development of physical security technology and nuclear materials management and control capability. Specific activities include:

- operation of the Nuclear Materials Analytical Laboratory and the Nuclear Materials Management and Safeguards Data System.
- continued assessment of safeguards in DOE facilities.
- support of the non-proliferation policy with regard to safeguards for selected proliferation-resistant fuel cycles.

GOVERNMENT-OWNED OPERATIONS

The Department of Energy is responsible for three major revenue producing activities, namely:

- the production and sale of enriched uranium services for use in nuclear powered electrical generating plants.
- the development and production of oil from the Naval Petroleum Reserves.
- the distribution and sale of electric power in five power marketing areas.

The revenues obtained from the sale of uranium enrichment services are used to offset directly the Department's enrichment costs. However, the receipts generated from the sale of oil from the Naval Petroleum Reserve and the marketing of power (with the exception of Bonneville) revert directly to the U.S. Treasury. A summary of the FY 1980 budget for these activities is shown below:

	Budget Authority (In Millions)	
	FY 1979	FY 1980
Production and Distribution Costs		
Uranium Enrichment	$ 1,290	$ 1,226
Naval Petroleum Reserve	120	69
Power Marketing	147	164
TOTAL	$ 1,557	$ 1,459
Revenues/Receipts		
Uranium Enrichment	$ 1,309	$ 1,310
Naval Petroleum Reserves	687	861
Power Marketing (Net)	298	336
TOTAL	$ 2,294	$ 2,507

URANIUM ENRICHMENT

The Department presently enriches uranium in three gaseous diffusion plants located at Oak Ridge, Tennessee; Portsmouth, Ohio and Paducah, Kentucky for domestic and foreign nuclear power reactor customers and to meet government requirements. The Department also has underway efforts to develop and utilize gas centrifuge technology to reduce the amount of electric power required for future enrichment requirements.

The FY 1980 budget recognizes a reduction in earlier forecasts of demand for uranium enrichment services due to delays and stretchouts in construction of planned nuclear generating capacity. This is reflected in FY 1980 by:

- a production level of 10.5 million separative work units (SWU).
- continued construction of the Portsmouth Gas Centrifuge Enrichment Plant to provide 2.2 million SWU of capacity by the end of 1988 with the potential for additional expansion to 8.8 million SWU by the end of 1988 ($323 million).
- revenues based on the sale of 11.6 million SWU.

NAVAL PETROLEUM RESERVE

The FY 1980 budget requests $69 million to operate, explore, conserve, develop and produce the Naval Petroleum Reserves. Outlays totaling $168 million are also provided out of balances remaining in the Funds Appropriated to the President (FAP) account.

The funds requested by the Department will provide for operation and maintenance of NPR 1, 2 and 3 and development drilling at NPR 3 of 41 additional wells. The FAP funds will support development drilling of 90 wells at NPR 1 as well as facility development at that location.

POWER MARKETING ADMINISTRATIONS

The FY 1980 budget for these activities totals $164 million, an increase of $17 million over FY 1979. No Budget Authority is included for the Bonneville Power Administration which operates as a revolving fund.

The Power Marketing Administrations market power produced at certain Federal hydroelectric generating projects in the U.S. utilizing high voltage transmission systems. The five Administrations included in this activity are the Alaska Power Administration; Bonneville Power Administration serving the northwest; and the Southeastern, Southwestern and Western Area Power Administrations.

STRATEGIC PETROLEUM RESERVE

In December 1975, legislation was enacted to establish a Strategic Petroleum Reserve of up to one billion barrels of oil in order to reduce the Nation's vulnerability to the effects of a severe petroleum supply interruption. The Administration continues to believe that the amount of protection that would be afforded by a billion barrel reserve is needed. Preparation of storage facilities and acquisition of oil is proceeding. It is now contemplated that 248 million barrels will be in storage by the end of 1980 and 750 million barrels by 1986.

Given the level of prior year appropriations and schedule revisions, no new budget authority is being requested in FY 1980 except $8 million for program direction. Budget outlays of $1.961 billion are planned. The FY 1980 budget, however, is predicated on an FY 1979 reprogramming of $745 million in petroleum acquisition funds to complete the first 248 million barrels of storage capacity, begin expansion of existing storage sites to provide 280 million barrels of storage, and to acquire three turnkey sites for an additional 80 million barrels of storage.

Execution of the FY 1979 reprogramming and FY 1980 budget would bring the storage capacity of sites on which work is underway or completed through 1980 to 608 million barrels. Included in the government-wide contingency is funding to support an additional 142 million barrels should program progress allow this increment which would total 750 million barrels.

DEPARTMENTAL ADMINISTRATION

Activities in this category include general management and administration of the Department, as well as policy studies and analyses, institutional and intergovernment relations, and efforts to conserve energy in DOE facilities.

FY 1980 funding requested for these activities totals $308 million, an increase of $56 million over the amended FY 1979 level. Major changes in FY 1980 include an increase in inventories for coal stockpiles, expansion of construction related to in-house energy management, and adjustments in management and support. A distribution of the request is provided below:

	Budget Authority (In Millions)	
	FY 1979	FY 1980
Policy Analysis and System Studies	$ 15	$ 19
International Affairs	4	4
Management and Support	227 1/	249
Intergovernmental and Institutional Relations	33	36
In-House Energy Management	25	41
Security Investigations	15	16
Other Supporting Activities	13	9
Cost of Work for Others	23	25
Miscellaneous Revenues	-113	-110
Changes in Inventories	10	19
TOTAL DEPARTMENTAL ADMINISTRATION	$ 252	$ 308

POLICY ANALYSIS AND SYSTEMS STUDIES

The FY 1980 request of $19 million will provide the funding necessary to:

- develop the National Energy Plan analytic base with particular stress on long-range analysis of alternatives to ensure adequate national energy supplies in the 1990's and beyond.

- complete the FY 1980 phase of coal competition and policy studies required by the Powerplant and Industrial Fuel Use Act of 1978.

1/Excludes $8.5 million pending reprogramming for personal services and benefits.

- improve the available data base for direction of ongoing Department programs, with a focus upon issues such as regulatory reform, technical program evaluations, and energy industry competition.

MANAGEMENT AND SUPPORT

This activity provides the salaries, travel and related personnel expenses associated with Headquarters staff functions, regional representation and multi-program field office support for the Department's programs. The FY 1980 request is $249 million. Staffing levels will decline in FY 1980 to 4,449 positions. This represents a decrease of 162 positions from the FY 1979 level. This decrease is a consequence of the Department's commitment to effect staffing economies through organizational consolidation.

In FY 1980, the Office of Minority Economic Impact will initiate the provision of loans to minority business enterprises to bid for and obtain Department contracts as authorized by the National Energy Conservation Policy Act of 1978. A request of $3 million is included for this purpose.

INTERGOVERNMENTAL AND INSTITUTIONAL RELATIONS

The FY 1980 funding level for the Intergovernmental and Institutional Relations program is $36 million. Efforts are directed toward increasing the public and private sector's understanding of the Nation's energy situation. Program initiatives are directed toward:

- the dissemination of technical energy-related information to business, state and local governments, academia, and individual citizens.

- outreach efforts that encourage public participation in the development and implementation of Federal energy policies and programs.

- informing interested and concerned citizens of energy programs and activities through the mass media, operation of DOE science museums, traveling exhibits, and other public communications channels.

IN-HOUSE ENERGY MANAGEMENT

The FY 1980 request of $41 million reflects a planned, gradual change in program emphasis toward expanded construction investment to achieve actual annual energy and cost savings in DOE facilities. Major program goals include reduction by 20 percent of existing DOE facility energy consumption by 1985 and elimination of in-house use of natural gas and petroleum as central heating plant fuels by 1995.

Specific program elements consist of:

- surveys to develop cost-effective retrofit projects for existing DOE buildings.
- two studies of major DOE central heating plants for fuel conversion.
- retrofit construction projects that employ selected energy management concepts and systems at various field sites to save energy and reduce overhead costs.
- conversion of a DOE oil burning central heating plant to use coal.

Included in this request is a $20 million construction line item, Modifications for Energy Management, comprised of small retrofit projects. These projects are selected on the basis of energy saved per investment dollar, total dollar return on investment, and payback rate. The average payback period for this project group is about four years. Investments in energy saving projects for the last three years will reduce total DOE energy consumption by 3.8 percent and cut annual in-house energy costs by $22 million upon completion of FY 1980 projects.

OTHER SUPPORTING ACTIVITIES

The remaining portion of Departmental Administration consists of small, level of effort programs such as Security Investigations, International Affairs, Plant Engineering and Design, and other adjustments. The aggregate FY 1980 funding request for these items is $73 million.

MISCELLANEOUS REVENUES

The FY 1980 estimate includes $110 million in miscellaneous revenues as compared to $113 million in FY 1979. Revenues come from sale and lease of products, materials, and services to eligible purchasers (e.g., sale of isotopes). Specifically excluded are receipts from Naval Petroleum Reserves and Power Marketing Administrations.

LEGISLATIVE PROPOSALS

SPENT FUEL STORAGE

This proposed legislation entitled "Spent Nuclear Fuel Act of 1979" will implement the Administration's spent fuel policy, announced by the President in October 1977. It will authorize DOE to accept spent nuclear fuel for storage and disposal in return for a one-time charge. The mechanism proposed for financing the spent fuel service is the establishment of a revolving fund. Revenues for the fund would be derived from the charges for spent fuel storage and disposal, proceeds from fund investment, proceeds derived from the sale of bonds to the Treasury, and any appropriation by Congress. Expenditures from the fund could be made without annual appropriation or fiscal year limitation.

The legislation would extend the licensing authority of the Nuclear Regulatory Commission (NRC) for the storage of spent fuel resulting from any other NRC licensed activity.

Finally, borrowing authority of $300,000,000 will be requested to construct the first storage facility. FY 1980 offsetting revenue collections are estimated to be $100,000,000.

STATE ENERGY MANAGEMENT PLANNING (SEMP)

This legislative proposal will simplify grants for State Energy Management and Planning (SEMP) which provides financial and technical assistance to States to: develop a State energy strategy plan, and implement energy conservation programs. The program restructures several existing grant programs and consolidates grant administration procedures for other State energy conservation programs administered by DOE.

FY 1979 SUPPLEMENTAL REQUESTS

The FY 1980 budget includes several supplemental requests for FY 1979. These supplementals, totaling $212 million, are highlighted below.

NATIONAL ENERGY ACT

In order to implement the provisions and requirements of the National Energy Act during FY 1979, $85 million is being requested. The funds will be provided to numerous DOE programs including Solar, Conservation, and Energy Information and Regulation.

DEFENSE ACTIVITIES

A supplemental request totaling $32 million is being requested in the Defense Programs. Funds are necessary to cover unanticipated cost increases on the New Plutonium Recovery and Waste Treatment Facility Project at Rocky Flats, Colorado due to an unstable labor force in the area ($23.5 million). The remaining $8.5 million is necessary to procure and install particulate emission control equipment at the Y-12 Steam Plant at Oak Ridge to comply with the Clean Air Act.

OTHER SUPPLEMENTALS

In addition to the NEA and Defense supplementals, there are several other small supplementals requested by the Department. These supplemental requests include funding for the Information Data Validation Program, for compliance activities related the Emergency Petroleum Allocation Act, for Federal leasing efforts, and for management and support activities including the pay raise which was effective in October 1978.

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DEPARTMENT OF ENERGY
FY 1980 BUDGET

SPECIAL ANALYSES

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FEDERAL SOLAR PROGRAM

Solar Technology and Biomass
($ In Tenths of Millions)

	FY 1979		FY 1980	
	BA	BO	BA	BO
Solar Thermal Electric	$102.1	$ 95.3	$121.0	$133.5
Photovoltaic Energy Development	105.8	93.3	130.0	117.0
Wind Energy Conversion	61.9	54.6	67.0	66.5
Ocean Systems	38.9	42.7	35.0	39.0
Solar Energy Research Institute Building	3.0	2.0	27.0	22.0
Biomass	43.2	27.6	57.0	55.0
Program Direction & Support	3.5	3.6	4.0	4.0
TOTAL, SOLAR TECHNOLOGY AND BIOMASS	358.4	319.1	441.0	437.0

Solar Applications

	FY 1979		FY 1980	
	BA	BO	BA	BO
Systems Development	41.0	40.1	47.0	43.0
Demonstration: Agricultural and Industrial Process Heat	11.0	11.2	14.0	12.5
Demonstrations: Residential and Commercial Buildings	55.0	69.0	35.5	44.0
Demonstrations: Federal Buildings ..	25.7	15.5	23.5	25.0
Demonstrations: Federal Photovoltaic Utilization Program	15.0	16.1	-	12.3
Commercialization	2.7	.9	5.0	3.1
Market Development and Training	16.6	12.1	27.0	20.1
Program Direction & Support	2.5	3.2	3.6	3.6
TOTAL, SOLAR APPLICATIONS	169.5	168.1	155.6	163.6
Other DOE Solar Related Funding	31.5	28.7	49.4	43.8
TOTAL DOE SOLAR FUNDING..........	559.4	515.9	646.0	644.4

Other Federal Solar Funding *

	FY 1979		FY 1980	
	BA	BO	BA	BO
Agency for International Development.	16.0	5.0	42.0	22.0
Department of Agriculture	22.0	22.0	27.0	27.0
Small Business Administration	5.0	3.0	14.0	11.0
Federal Buildings Investments	20.0	15.0	25.0	25.0
Tennessee Valley Authority	8.0	8.0	16.0	16.0
Tax credits	88.0	88.0	74.0	74.0
TOTAL, OTHER FEDERAL SOLAR FUNDING.	159.0	141.0	198.0	175.0
TOTAL FEDERAL SOLAR PROGRAMS.....	$718.4	$656.9	$844.0	$819.4

* Includes tax Credits and TVA funding which are off budget.

NATIONAL ENERGY ACT
ANALYSIS OF DOE FUNDING

The National Energy Act is composed of five laws. In FY 1980, approximately $321 million is requested to undertake implementation responsibilities for these National Energy Acts.

	Budget Authority (In Millions)	
	FY 1979	FY 1980
The Natural Gas Policy Act......................	$ 17	$ 24
The National Energy Conservation Policy Act.....	361	235
The Power Plant and Industrial Fuel Use Act.....	31	20
The Public Utilities Regulatory Policy Act......	30	40
The Energy Tax Act..............................	-	2
TOTAL DOE-NEA................................	$439	$321

THE NATURAL GAS POLICY ACT

DOE programs will develop regulations to establish and enforce policies for natural gas pricing, production, transmission, and distribution. Data collection is an essential part of this effort.

THE NATIONAL ENERGY CONSERVATION POLICY ACT

DOE programs will encourage energy conservation and increased utilization of solar energy. Conservation efforts will be primarily in the area of grants to States for conservation retrofit (particularly for homes of handicapped and elderly). Utilization of solar technology will be encouraged through the demonstration of the technology on Federal buildings and through expanded market development activities.

THE POWER PLANT AND INDUSTRIAL FUEL USE ACT

DOE programs will encourage the use of coal rather than oil or natural gas in power plants and industrial burners.

THE PUBLIC UTILITIES REGULATORY POLICIES ACT

DOE programs will encourage electric utilities to institute new ratemaking standards, study the use of electric power pooling and wheeling, and encourage municipalities to develop small hydroelectric projects on dams which do not presently generate electric power.

THE ENERGY TAX ACT

DOE programs will develop for the Internal Revenue Service definitions for industrial equipment which qualifies for NEA tax credits. The Internal Revenue Service estimates that the loss of Federal revenues as a result of the Tax Credits will be $1.0 Billion in FY 1979 and $0.848 Billion in FY 1980.

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DOE NUCLEAR WASTE MANAGEMENT PROGRAMS
($ in Millions)

	FY 1979		FY 1980	
	BA	BO	BA	BO
Defense Waste Management	$257.0	$277.9	$371.9	$406.2
Commercial Waste Management	190.7	166.9	199.4	193.6
Spent Fuel Storage	11.4	7.4	320.5	27.3
Decontamination & Decommissioning	25.4	23.9	32.6	28.4
TOTAL NUCLEAR WASTE	$484.5	$476.1	$924.4	$655.5

The Department's Nuclear Waste efforts are to be increased significantly in two areas for FY 1980: 1) the Spent Fuel Storage program for implementation of the President's October 1977 commitment to provide interim storage for commercially generated spent nuclear fuel, and 2) increased efforts in Defense Waste Management aimed at long-term solutions for defense nuclear waste disposal.

- Separate legislation is being proposed in early 1979 to authorize the Department to acquire and operate spent fuel storage facilities for commercial nuclear fuels by 1983. This legislation will also authorize DOE to make a one time spent fuel storage charge on users sufficient to cover all costs of storage and disposal incurred by the government. Three hundred million dollars of this funding will be requested in separate enabling legislation with FY 1980 estimated offsetting revenues of $100 million.

- The $115 million increase in Defense Waste Management includes funding for handling storage and transfer of high level and transuranic waste forms, continuation of design work for the Waste Isolation Pilot Plant (WIPP), operation of Waste Calcining Facilities, transportation R&D and related studies all geared toward optimum long-term spent fuel disposition.

Commercial waste management with funding of $199 million will continue work on a deep geologic nuclear waste repository for commercially generated waste with expanded efforts in the evaluation of various geological environments, including non-salt media.

The Decontamination and Decommissioning program will shift its emphasis from planning, engineering studies and cleanup of DOE-owned facilities to cleanup operations for remedial action at several former Manhattan Engineer District/Atomic Energy Commission facilities.

DEPARTMENT OF ENERGY
FY 1980 BUDGET

STATISTICAL APPENDIX

ERRATA SHEET

DEPARTMENT OF ENERGY
FY 1980 BUDGET
(In millions of dollars)

SUMMARY BY APPROPRIATION

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
ATOMIC ENERGY DEFENSE ACTIVITIES - OPERATING EXPENSES	2,167	2,089	2,394	2,320
ATOMIC ENERGY DEFENSE ACTIVITIES - PLANT AND CAPITAL EQUIPMENT	459	453	628	640
GENERAL SCIENCE AND RESEARCH - OPERATING EXPENSES	309	306	338	332
GENERAL SCIENCE AND RESEARCH - PLANT AND CAPITAL EQUIPMENT	122	114	136	121
ENERGY SUPPLY RESEARCH AND DEVELOPMENT - OPERATING EXPENSES	2,143	2,086	2,284	2,188
ENERGY SUPPLY RESEARCH AND DEVELOPMENT - PLANT AND CAPITAL EQUIPMENT	411	368	408	440
FOSSIL ENERGY RESEARCH AND DEVELOPMENT	658	731	670	700
FOSSIL ENERGY CONSTRUCTION ...	100	90	77	73
URANIUM ENRICHMENT - OPERATING EXPENSES	6	-36	...	56
URANIUM ENRICHMENT - PLANT AND CAPITAL EQUIPMENT	47	164	...	-39
ENERGY PRODUCTION, DEMONSTRATION AND DISTRIBUTION	172	180	122	119
ENERGY CONSERVATION	630	488	555	636
STRATEGIC PETROLEUM RESERVE	3,008	2,367	8	1,961
ENERGY INFORMATION ADMINISTRATION	63	63	89	83

ERRATA SHEET

DEPARTMENT OF ENERGY
FY 1980 BUDGET
(In millions of dollars)

SUMMARY BY APPROPRIATION - continued

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
ECONOMIC REGULATORY ADMINISTRATION	91	88	160	137
FEDERAL ENERGY REGULATORY COMMISSION	51	50	74	66
SPECIAL FOREIGN CURRENCY	2	2	...	1
GEOTHERMAL RESOURCES DEVELOPMENT FUND	...	6	6	1
ALASKA POWER ADMINISTRATION - OPERATION AND MAINTENANCE .	3	3	3	3
BONNEVILLE POWER ADMINISTRATION	...	74	...	-89
SOUTHEASTERN POWER ADMINISTRATION - OPERATION AND MAINTENANCE .	1	1	1	1
SOUTHWESTERN POWER ADMINISTRATION - OPERATION AND MAINTENANCE .	36	33	32	32
WESTERN AREA POWER ADMINISTRATION - CONSTRUCTION, REHABILITATION OPERATION AND MAINTENANCE	104	104	123	123
WESTERN AREA POWER ADMINISTRATION - COLORADO RIVER BASIN......	2	1	5	5
SOUTHEASTERN POWER ADMINISTRATION - CONTINUING FUND	...	...	...	...
WESTERN AREA POWER ADMINISTRATION - EMERGENCY FUND	...	...	...	...
DEPARTMENTAL ADMINISTRATION	214	266	308	300
TOTAL DEPARTMENT OF ENERGY	10,799	10,089	8,423	10,213

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

ATOMIC ENERGY DEFENSE ACTIVITIES APPROPRIATIONS

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
INERTIAL CONFINEMENT FUSION .	$ 144.1	$ 133.5	$ 145.9	$ 145.1
NAVAL REACTOR DEVELOPMENT				
Submarine Propulsion Reactors	188.4	178.7	185.2	170.3
Surface Ship Propulsion Reactors	82.3	63.7	64.7	74.6
Supporting R&D................	18.9	18.7	19.7	18.5
Program Direction	7.2	7.7	8.2	8.2
TOTAL NAVAL REACTOR DEVELOPMENT	296.8	268.8	278.4	271.6
WEAPONS ACTIVITIES				
Research & Development	477.2	451.3	543.5	514.6
Testing	224.4	228.9	219.8	219.4
Production & Surveillance ...	733.0	696.0	858.3	847.0
Program Direction	33.5	36.8	37.3	37.3
Other Capital Equipment	8.4	7.1	8.4	7.8
TOTAL WEAPONS ACTIVITIES ..	1,468.1	1,413.0	1,658.9	1,618.3
VERIFICATION AND CONTROL TECHNOLOGY	29.8	29.2	37.9	36.7
MATERIALS PRODUCTION				
Production Reactor Operations	174.6	174.4	181.2	183.4
Processing of Nuclear Materials	94.5	88.9	112.2	95.2
Supporting Services	97.9	87.8	92.3	98.7
Flourinel Processing	76.0	46.5	96.0	69.0
Program Direction	0	0.9	0.9	0.9
TOTAL MATERIALS PRODUCTION	443.0	398.5	482.6	447.2

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

ATOMIC ENERGY DEFENSE ACTIVITIES APPROPRIATIONS - continued

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
DEFENSE WASTE MANAGEMENT				
Interim Waste Operations	$ 161.7	$ 193.1	$ 175.1	$ 238.6
Long Term Technology	62.3	53.9	111.9	98.0
Terminal Storage	28.3	26.7	76.3	61.6
Decontamination & Decommissioning	0.6	0.5	2.0	2.0
Transporation R&D	2.6	2.1	5.0	4.3
Program Direction	1.5	1.6	1.7	1.7
TOTAL DEFENSE WASTE MANAGEMENT	257.0	277.9	372.0	406.2
NUCLEAR MATERIALS SECURITY AND SAFEGUARDS	46.1	41.8	46.6	42.6
SUBTOTAL ATOMIC ENERGY DEFENSE ACTIVITIES	2,684.9	2,562.7	3,022.3	2,967.7
SUPPLEMENTALS	-35.5	-21.1	0	-8.0
UNOBLIGATED BALANCES	-23.5			
TOTAL ATOMIC ENERGY DEFENSE ACTIVITIES APPROPRIATIONS	$ 2,625.9	$ 2,541.6	$ 3,022.3	$ 2,959.7

APPROPRIATION SUMMARY

	FY 1979 BA	FY 1979 BO	FY 1980 BA	FY 1980 BO
OPERATING EXPENSES	2,167.2	2,088.8	2,394.4	2,320.0
PLANT AND CAPITAL EQUIPMENT	458.7	452.8	627.9	639.7
TOTAL	$ 2,625.9	$ 2,541.6	$ 3,022.3	$ 2,959.7

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

GENERAL SCIENCE AND RESEARCH APPROPRIATIONS

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
BASIC SCIENCES				
Life Sciences Research and Biomedical Applications:				
General Life Sciences	$ 23.7	$ 23.2	23.7	22.4
Biomedical Applications ...	16.9	16.6	18.3	17.4
Program Direction	0.2	0.2	0.2	0.2
Subtotal Life Sciences Research	40.8	40.0	42.2	40.0
High Energy Physics:				
Physics Research	72.2	70.2	79.1	77.3
Facility Operations	182.8	179.3	202.9	189.3
High Energy Technology	39.1	38.1	40.7	39.7
Other Capital Equipment ...	0.8	1.0	1.1	1.1
Program Direction	2.5	2.4	3.3	2.7
Subtotal High Energy Physics	297.4	291.0	327.1	310.1
Nuclear Physics:				
Medium Energy Physics	42.9	41.5	50.6	46.3
Heavy Ion Physics	43.0	40.8	46.7	49.2
Nuclear Theory	5.7	5.6	6.1	5.9
Other Capital Equipment ...	0.3	0.3	0.4	0.4
Program Direction	1.0	0.8	1.0	1.0
Subtotal Nuclear Physics	92.9	89.0	104.8	102.8
TOTAL GENERAL SCIENCE AND RESEARCH APROPRIATIONS	$ 431.1	$ 420.0	$ 474.1	$ 452.9

APPROPRIATIONS SUMMARY

	FY 1979 BA	FY 1979 BO	FY 1980 BA	FY 1980 BO
OPERATING EXPENSES	$ 309.4	$ 306.0	$ 337.6	$ 332.0
PLANT AND CAPITAL EQUIPMENT	121.7	114.0	136.5	120.9
TOTAL	$ 431.1	$ 420.0	$ 474.1	$ 452.9

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

ENERGY SUPPLY RESEARCH AND DEVELOPMENT APPROPRIATIONS

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
SOLAR APPLICATIONS				
Systems Development	$ 41.0	$ 40.0	$ 47.0	$ 43.0
Demonstrations				
Buildings	55.0	69.0	35.5	44.0
Agricultural and Industrial Process Heat	11.0	11.2	14.0	12.5
Federal Photovoltaics	15.0	16.1	0	12.3
Market Development and Training	16.6	12.1	27.0	20.1
Program Direction	2.0	2.5	2.9	2.9
TOTAL SOLAR APPLICATIONS ..	140.6	150.9	126.4	134.8
SOLAR TECHNOLOGY				
Technology Support and Utilization	6.7	4.6	0	0
Solar Thermal Systems	100.1	94.0	121.0	133.5
Photovoltaics	103.8	91.9	130.0	117.0
Wind Energy	60.7	53.8	67.0	66.5
Ocean Systems	38.2	42.2	35.0	39.0
Solar Energy Research Institute	3.0	2.0	27.0	22.0
Program Direction	2.9	3.0	3.1	3.1
TOTAL SOLAR TECHNOLOGY	315.4	291.5	383.1	381.1
GEOTHERMAL				
Hydrothermal Resources	70.9	59.8	59.1	56.5
Geopressured Resources	27.7	24.8	36.0	34.1
Geothermal Technology Development	57.6	50.6	43.9	41.4
Program Direction	1.8	1.8	1.9	1.9
TOTAL GEOTHERMAL	158.0	137.0	140.9	133.9

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

ENERGY SUPPLY RESEARCH AND DEVELOPMENT APPROPRIATIONS - continued

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
BIOMASS	$ 43.0	$ 27.7	$ 57.8	$ 55.8
HYDROPOWER PROJECTS				
Low Head Hydro Development ..	18.0	13.0	6.0	7.1
Feasibility Studies Loan	10.0	10.0	10.0	10.0
Program Direction	0.4	0.4	0.5	0.5
TOTAL HYDROPOWER PROJECTS .	28.4	23.4	18.5	17.6
NUCLEAR				
Converter				
Thermal Reactor Technology	23.9	22.8	37.0	35.0
Advanced Reactor Systems ..	0	0	10.0	9.5
Gas Cooled Thermal Reactors	42.0	33.5	0	13.0
Advanced Isotope Separation Technology	54.2	53.0	55.0	54.9
Program Direction	1.8	1.9	2.2	2.2
Subtotal	121.9	111.2	104.2	114.6
Commercial Waste Management .	190.7	166.9	199.4	193.6
Spent Fuel Disposition				
International Spent Fuel Storage	3.0	3.0	4.2	4.0
Domestic Spent Fuel Storage	8.0	4.0	15.8	14.0
Program Direction	0.4	0.4	0.5	0.5
Subtotal	11.4	7.4	20.5	18.5
Advanced Nuclear Systems				
Space and Terrestrial Applications	43.1	41.5	36.4	41.0
Advanced Systems Evaluations	10.3	12.3	2.6	4.6
Program Direction	1.2	1.2	1.3	1.3
Subtotal	54.6	55.0	40.3	46.9

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

ENERGY SUPPLY RESEARCH AND DEVELOPMENT APPROPRIATIONS - continued

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
Breeder				
Liquid Metal Fast Breeder Reactor	$ 566.7	$ 593.5	$ 462.0	$ 469.3
Water Cooled Breeder Reactor	63.0	51.7	60.0	69.0
Gas Cooled Breeder Reactor	26.0	23.2	26.0	26.0
Fuel Cycle R&D	75.6	74.9	30.0	35.0
Program Direction	10.4	11.0	11.9	11.9
Subtotal	741.7	754.3	589.9	611.2
Light Water Reactor Facilities	10.0	16.6	0	2.8
TOTAL NUCLEAR	1,130.3	1,111.4	954.3	987.6
MAGNETIC FUSION				
Confinement Systems	140.0	116.6	136.8	123.5
Development and Technology ..	58.9	57.4	57.6	57.3
Applied Plasma Physics	65.3	65.2	75.6	75.0
Reactor Projects	88.9	99.4	90.9	108.2
Program Direction	2.9	2.9	3.2	3.2
TOTAL MAGNETIC FUSION	356.0	341.5	364.1	367.2
ELECTRIC ENERGY SYSTEMS AND STORAGE				
Electric Energy Systems				
Power Supply and System Management	15.5	13.7	17.0	15.0
Power Delivery	24.5	24.3	9.0	11.0
Program Direction	1.4	1.4	1.5	1.5
Subtotal	41.4	39.4	27.5	27.5
Energy Storage Systems				
Battery Storage	25.4	23.0	33.1	31.5
Chemical Mechanical and Other Storage	32.6	26.0	31.9	30.5
Program Direction	1.3	1.3	1.4	1.4
Subtotal	59.3	50.3	66.4	63.4
TOTAL ELECTRIC ENERGY SYSTEMS AND STORAGE	100.7	89.7	93.9	90.9

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

ENERGY SUPPLY RESEARCH AND DEVELOPMENT APPROPRIATIONS - continued

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
ENVIRONMENT				
Environmental Research and Development				
Overview and Assessment ...	$ 51.5	$ 49.4	$ 60.6	$ 55.1
Biomedial and Environmental Research	158.3	151.5	172.3	168.2
Program Direction	9.5	10.8	12.2	12.2
Subtotal	219.3	211.7	245.1	235.5
Decontamination and Decommissioning	25.4	23.9	32.6	28.4
TOTAL ENVIRONMENT	244.7	235.6	277.7	263.9
BASIC RESEARCH				
Basic Energy Sciences				
Nuclear Sciences	29.7	29.0	32.0	31.0
Materials Sciences	94.1	88.4	99.4	100.7
Chemical Sciences	54.7	53.3	69.3	67.2
Engineering, Mathematical and Geosciences	16.5	16.2	25.4	24.8
Advanced Energy Projects ..	7.5	7.2	16.8	16.0
Biological Energy Conversion and Conservation	4.0	3.9	7.2	6.9
Other Capital Equipment ...	1.8	2.3	2.6	2.5
Program Direction	0.1	0.1	0.1	0.1
Subtotal	204.8	200.4	252.8	249.2

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

ENERGY SUPPLY RESEARCH AND DEVELOPMENT APPROPRIATIONS - continued
DETAIL LEVEL

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
Technical Assessment Projects	7.1	6.1	11.4	10.9
University Research Support .	2.9	2.7	9.2	6.2
Technical Program and Policy Analysis	1.7	2.1	2.4	2.4
TOTAL BASIC RESEARCH	220.1	211.3	275.8	268.7
SUBTOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT	$ 2,737.2	$ 2,620.0	$ 2,692.5	$ 2,701.5
SUPPLEMENTALS	- 16.4	- 12.9	0	0
GENERAL REDUCTION AND UNOBLIGATED BALANCES	-165.8	0	0	0
COST OUTLAY ADJUSTMENT	0	-152.8	0	-73.0
TOTAL ENERGY SUPPLY RESEARCH AND DEVELOPMENT APPROPRAITONS	$ 2,555.0	$ 2,454.3	$ 2,692.5	$ 2,628.5

APPROPRIATIONS SUMMARY

	FY 1979 BA	FY 1979 BO	FY 1980 BA	FY 1980 BO
OPERATING EXPENSES	2,143.5	2,086.5	2,284.0	2,188.6
PLANT AND CAPITAL EQUIPMENT	411.5	367.8	408.5	439.9
TOTAL	$ 2,555.0	$ 2,454.3	$ 2,692.5	$ 2,628.5

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

FOSSIL ENERGY RESEARCH AND DEVELOPMENT APPROPRIATIONS

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
COAL				
Mining Research and Development	$ 76.1	$ 70.4	$ 60.3	$ 96.1
Coal Liquefaction	206.4	143.2	122.3	79.3
Surface Coal Gasification ...	159.6	163.2	169.3	167.6
In-Situ Coal Gasification ...	15.0	15.3	10.0	9.7
Advanced Research and Technology Development	46.4	47.7	51.0	51.6
Advanced Environmental Control Technology	7.0	3.5	43.2	24.0
Heat Engines and Heat Recovery	58.0	51.0	46.0	63.0
Combustion Systems	58.9	67.0	57.4	74.7
Fuel Cells	41.0	32.4	20.0	17.7
Magnetohydrodynamics	80.0	78.3	72.0	71.0
Clean Boiler Fuel Reduction .	-78.0	0	0	0
Program Direction	10.3	10.6	11.1	11.1
TOTAL COAL	680.7	682.6	662.6	665.8
PETROLEUM				
Enhanced Oil Recovery	54.0	46.9	21.4	34.4
Oil Shale	48.6	48.6	28.2	29.1
Drilling and Offshore Technology	2.6	2.9	3.0	2.0
Advanced Process Technology .	2.2	1.3	4.0	3.0
Program Direction	0.7	0.7	0.8	0.8
SUBTOTAL PETROLEUM	108.1	100.4	57.4	69.3
GAS				
Enhanced Gas Recovery	33.9	40.2	27.6	40.4
Fossil Energy General Reduction	-63.0	0	0	0
SUBTOTAL FOSSIL ENERGY RESEARCH AND DEVELOPMENT ..	$ 759.7	$ 823.2	$ 747.6	$ 775.5

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

FOSSIL ENERGY RESEARCH AND DEVELOPMENT APPROPRIATIONS - continued

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
SUPPLEMENTAL	$ -2.3	$ -2.3	$ 0	$ 0
COST OUTLAY ADJUSTMENT	0	0	0	-1.7
TOTAL FOSSIL ENERGY RESEARCH AND DEVELOPMENT APPROPRAITONS	$ 757.4	$ 820.9	$ 747.6	$ 773.8

APPROPRIATIONS SUMMARY

OPERATING EXPENSES AND CAPITAL EQUIPMENT	657.7	730.6	670.6	700.4
PLANT	99.7	90.3	77.0	73.4
TOTAL	$ 757.4	$ 820.9	$ 747.6	$ 773.8

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

URANIUM ENRICHMENT APPROPRIATIONS

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
URANIUM ENRICHMENT ACTIVITIES				
Gaseous Diffusion Operations and Support	$ 1,064.2	$ 1,173.2	$ 827.6	$ 934.3
Gas Centrifuge Operations and Support	241.0	198.1	409.3	310.8
Revenues	-1,309.0	-1,309.0	-1,310.0	-1,310.0
Program Direction	6.0	6.4		
General Reduction	-18.0	0	-63.0	0
Subtotal Uranium Enrichment Activities	- 15.8	68.7	- 129.3	- 58.1
URANIUM RESOURCE ASSESSMENT	69.4	58.8	80.0	74.3
SUBTOTAL URANIUM ENRICHMENT ACTIVITIES	$ 53.6	$ 127.5	$ - 49.3	$ 16.2
SUPPLEMENTAL	-0.3	-0.3	0	0
UNOBLIGATED BALANCES BROUGHT FORWARD	0	0	+ 49.3	0
TOTAL URANIUM ENRICHMENT ACTIVITIES APPROPRIATIONS	$ 53.3	$ 127.2	$ 0	$ 16.2

APPROPRIATIONS SUMMARY

OPERATING EXPENSES	6.5	-36.5	0	55.7
PLANT AND CAPITAL EQUIPMENT	46.8	163.7	0	-39.5
TOTAL	$ 53.3	$ 127.2	$ 0	$ 16.2

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

ENERGY PRODUCTION DEMONSTRATION AND DISTRIBUTION APPROPRIATION

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
COAL				
Loan Guarantee Program	$ 0	$ 0.4	$ 0	$ 0
Utilization and Supply Projects	0.3	0.3	4.5	4.0
Program Direction	2.3	2.4	2.5	2.5
TOTAL COAL	2.6	3.1	7.0	6.5
OIL				
Naval Petroleum Reserves				
Petroleum Reserves 1 and 2 (California)	94.6	125.5	52.9	53.0
Petroleum Reserve 3 (Wyoming)	25.3	18.3	16.1	15.0
Subtotal	119.9	143.8	69.0	68.0
Shale Oil Development Program	$ 2.3	$ 1.5	$ 5.0	$ 5.0
Oil and Gas Development Projects	0.4	0.4	3.0	2.5
Program Direction	4.6	4.9	5.7	5.7
TOTAL OIL	127.2	150.6	82.7	81.2
SOLAR				
Federal Buildings Program	25.7	15.5	23.5	25.0
Commercialization	2.7	0.9	5.0	3.1
Program Direction	0.5	0.7	0.7	0.7
TOTAL SOLAR	28.9	17.1	29.2	28.8
MULTI RESOURCE				
Alternate Fuels Loan Guarantee Program	7.0	4.0	0	0
Federal Leasing	1.0	1.0	2.0	1.6
Urban Waste	5.0	4.0	0	0
Program Direction	1.2	1.2	1.4	1.4
TOTAL MULTI RESOURCE	14.2	10.2	3.4	3.0

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

ENERGY PRODUCTION DEMONSTRATION AND DISTRIBUTION APPROPRIATION - continued

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
SUBTOTAL ENERGY PRODUCTION DEMONSTRATION AND DISTRIBUTION	$ 172.9	$ 181.0	$ 122.3	$ 119.5
SUPPLEMENTALS	-1.4	-1.4	0	0
TOTAL ENERGY PRODUCTION DEMONSTRATION AND DISTRIBUTION APPROPRIATION	$ 171.5	$ 179.6	$ 122.3	$ 119.5

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

ENERGY CONSERVATION APPROPRIATION

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
CONSERVATION				
Buildings and Community Systems	$ 86.0	$ 79.0	$ 86.0	$ 74.8
Industrial	40.0	38.7	42.3	40.2
Transportation				
Vehicle Propulsion Research and Development	47.8	35.8	43.0	43.0
Electric and Hybrid Vehicle Research, Development, and Demonstration	37.5	37.0	41.0	41.0
Alternative Fuels Utilization	5.8	4.7	5.3	5.3
Other Transportation Programs	8.1	8.5	9.6	9.6
Subtotal	99.2	86.0	98.9	98.9
State and Local				
Schools and Hospitals Grant Program	100.1	59.7	2.5	138.7
Other Local Government Buildings Grant Program	29.8	18.0	0.2	17.0
Weatherization Assistance Program	199.0	128.5	199.0	174.0
Program Direction	4.3	4.8	4.1	4.1
Subtotal	333.2	210.9	205.8	333.8
State Energy Management and Planning	82.8*	78.6*	110.0*	96.4*
Conservation Multi-Sector				
Appropriate Technology	8.0	8.0	8.5	8.2
Energy Impact Assistance	20.0	1.0	0	5.0
Inventors Program	2.0	2.0	3.2	2.5
Program Direction	0.2	0.4	0.6	0.6
Subtotal	30.2	11.4	12.3	16.3
SUBTOTAL ENERGY CONSERVATION	$ 671.4	$ 504.7	$ 555.3	$ 660.4
SUPPLEMENTALS	-41.0	-17.1	0	-23.9
TOTAL ENERGY CONSERVATION APPROPRIATION	$ 630.4	$ 487.6	$ 555.3	$ 636.5

* In FY 1980 Energy Policy and Conservation Act (EPCA), Energy Conservation and Production Act (ECPA), and Energy Extension Services (EES) will be consolidated into the State Energy Management and Planning (SEMP) legislative proposal which is being submitted with the FY 1980 budget.

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

STRATEGIC PETROLEUM RESERVE APPROPRIATION

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
STRATEGIC PETROLEUM RESERVE				
Planning	$ 24.2	$ 28.8	$ 0	$ 10.0
Petroleum Acquisition and Transportation	2,140.7	1,681.4	0	1,413.9
Site Design and Construction	836.2	650.9	0	528.4
Program Direction	6.7	6.7	8.4	8.4
SUBTOTAL STRATEGIC PETROLEUM RESERVE	$ 3,007.8	$ 2,367.8	$ 8.4	$ 1,960.7
SUPPLEMENTAL	-0.3	-0.3	0	0
TOTAL STRATEGIC PETROLEUM RESERVE APPROPRIATION	$ 3,007.5	$ 2,367.5	$ 8.4	$ 1,960.7

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

ENERGY INFORMATION ADMINISTRATION APPROPRIATION

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
ENERGY INFORMATION				
Energy Applied Analysis	$ 14.0	$ 13.2	$ 13.9	$ 15.4
Collection, Production, and Dissemination	43.9	39.7	47.4	49.7
Data Validation	10.9	8.9	15.6	13.6
Data Information Services ...	10.6	10.6	11.8	11.8
SUBTOTAL ENERGY INFORMATION ADMINISTRATION	$ 79.4	$ 72.4	$ 88.7	$ 90.5
SUPPLEMENTALS	-16.0	-9.0	0	-7.0
TOTAL ENERGY INFORMATION ADMINISTRATION APPROPRIATION	$ 63.4	$ 63.4	$ 88.7	$ 83.5

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

ECONOMIC REGULATORY ADMINISTRATION APPROPRIATION

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
REGULATION				
Coal Utilization	$ 14.4	$ 13.4	$ 20.3	$ 16.6
Utility Programs and Regulatory Intervention	19.6	19.2	30.7	28.2
Compliance	55.5	55.8	60.4	58.0
ERA Regulation Development ..	2.1	1.9	5.3	4.6
Fuels Regulation	6.3	5.6	5.2	5.8
Emergency Preparedness	30.6	10.5	32.6	38.2
Program Administration	1.5	1.4	2.1	2.1
Office of Hearing and Appeals	2.7	2.7	3.0	3.0
SUBTOTAL ECONOMIC REGULATORY ADMINISTRATION	$ 132.7	$ 110.5	$ 159.6	$ 156.5
SUPPLEMENTALS	-42.1	-23.0	0	-19.1
TOTAL ECONOMIC REGULATORY ADMINISTRATION APPROPRIATION	$ 90.6	$ 87.5	$ 159.6	$ 137.4

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

FEDERAL ENERGY REGULATORY COMMISSION APPROPRIATION

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
REGULATION				
Oil Regulations	$ 5.1	$ 4.2	$ 5.0	$ 4.6
Gas Regulations	33.8	31.6	41.3	38.8
Hydro Regulations	10.9	10.2	12.5	11.8
Multi-Resource Regulations ..	14.0	13.1	15.1	14.3
SUBTOTAL FEDERAL ENERGY REGULATORY COMMISSION	$ 63.8	$ 59.1	$ 73.9	$ 69.5
SUPPLEMENTALS	-12.5	-9.3	0	-3.2
TOTAL FEDERAL ENERGY REGULATORY COMMISSION APPROPRIATION	$ 51.3	$ 49.8	$ 73.9	$ 66.3

SPECIAL FOREIGN CURRENCY APPROPRIATION

INTERNATIONAL AFFAIRS	$ 2.0	$ 1.5	$ 0	$ 0.9
OTHER SPECIAL FOREIGN CURRENCY	0	1.0	0	0
TOTAL SPECIAL FOREIGN CURRENCY APPROPRIATION ...	$ 2.0	$ 2.5	$ 0	$ 0.9

GEOTHERMAL RESOURCES DEVELOPMENT FUND APPROPRIATION

GEOTHERMAL RESOURCES DEVELOPMENT FUND APPROPRIATION	$ 0.3	$ 0.3	$ 0.3	$ 1.0

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DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

POWER MARKETING ADMINISTRATION APPROPRIATIONS

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
TOTAL ALASKA POWER ADMINISTRATION	$ 2.6	$ 2.6	$ 2.7	$ 2.7
TOTAL BONNEVILLE POWER ADMINISTRATION	$ 0	$ 73.5	$ 0	$ -88.6
TOTAL SOUTHEASTERN POWER ADMINISTRATION	$ 1.2	$ 1.2	$ 1.4	$ 1.4
TOTAL SOUTHWESTERN POWER ADMINISTRATION	$ 35.9	$ 32.9	$ 32.2	$ 32.2
TOTAL WESTERN AREA POWER ADMINISTRATION	$ 105.7	$ 104.4	$ 128.2	$ 128.2

DEPARTMENT OF ENERGY
FY 1980 BUDGET
($ IN MILLIONS)

DEPARTMENTAL ADMINISTRATION APPROPRIATION

	FY 1979 ESTIMATE		FY 1980 ESTIMATE	
	BA	BO	BA	BO
POLICY AND MANAGEMENT				
Policy Analysis and Systems Studies	$ 14.6	$ 14.6	$ 18.5	$ 18.5
International Affairs	4.2	3.6	3.5	3.5
Management and Support	226.6	276.4	248.5	248.5
Intergovernmental and Institutional Relations	33.3	33.3	36.4	35.9
In-House Energy Management ..	25.0	6.9	41.0	31.5
Security Investigations	14.7	14.6	16.4	16.4
Other Supporting Activities .	13.6	13.4	9.0	14.6
Miscellaneous	-80.3	-66.5	-65.5	-65.0
Subtotal Policy and Management	251.6	296.3	307.8	303.9
TRANSFERS TO OTHER AGENCIES .	4.3	4.3	0	0
SUPPLEMENTALS	-42.2	-34.2	0	-3.5
TOTAL DEPARTMENTAL ADMINISTRATION APPROPRIATION	$ 213.7	$ 266.4	$ 307.8	$ 300.4